B 812632

Per.

ASHRAE JOURNAL

OFFICIAL PUBLICATION

Heating • Refrigerating • Air Conditioning • Ventilating

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS, INC

THE LIBRARY OF CONGRESS
SERIAL RECORD
JAN 28 1960

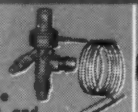
JANUARY 1960

THERMOSTATIC EXPANSION VALVES

207C Adjustable superheat, internally equalized. R-12, 22, 40. Cap. ¼ - 1½ tons, R-12.

207D Adjustable superheat, internal or external-type equalizer. R-12, 22, 40. Cap. ½ - 3 tons, R-12.

214 Adjustable superheat. External-type equalizer. Solder connections. R-12, 22. Cap. 1 - 3 tons, R-12.



209 Adjustable superheat and pressure limit. Internal or external-type equalizer. R-12, 22, 40. Cap. ½ - 1½ tons, R-12.

217 Adjustable superheat. External-type equalizer. Solder connections. R-12, 22. Cap. 5 - 12½ tons, R-12

218 Duo-flo construction. Adjustable superheat. External-type equalizer. R-12, 22. Cap. 16-25 tons, R-12.

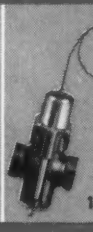
AUTO. EXPANSION VALVES

204C Calibrated adjustment (no gauge needed). R-12, 22, 40. Cap. ½ ton, R-12.

304C Adjustable 10" to 75 psig. R-12, 22, 40. Cap. 1 ton, R-12.

WATER REG. VALVES

65A New self-cleaning, chatterproof, sliding action. 63-300 psig. ⅜", ½", ¾" NPT

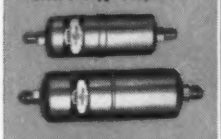


65, 65H Large capacity — up to 80 gpm at 50 psig. water pressure. 70-170 psig. R-12. 1", 1¼" NPT.

VALVES FILTERS DRIERS

FOR REFRIGERATION, AIR CONDITIONING

FILTERS AND DRIERS

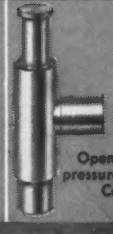


410 New Trap-Dri. Removes acid, water, dirt. 1-7½ tons, R-12.

408 Trap-it filter. Removes dirt. ¼" to ⅝" flare connections.

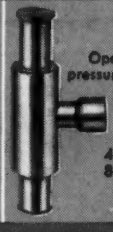
414 Jet-Dri. Removes water, acid. ¼" flare connections.

PRESSURE REGULATING VALVES



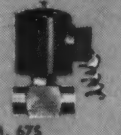
237 Opens on outlet pressure decrease. Cap. 1½ - 3 tons, R-12.

235S Opens on inlet pressure increase. Adjustable 0-40 psig, 20-70 psig.



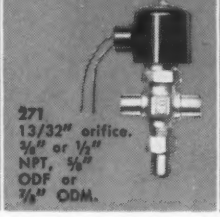
239 Opens on inlet pressure increase. Cap. 6-14 tons, liquid R-12. Adjustable 40-140 psig, 80-210 psig.

SOLENOID VALVES FOR NONCORROSIVE REFRIGERANTS OR WATER

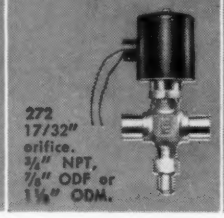


67M, 67S Metal-to-metal or soft resilient seat. 3/32" orifice. ⅜" NPT or OD solder.

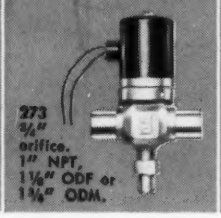
73 Quiet, floating plunger. 5/32", 3/16" or 7/32" orifice. ⅜" NPT, flare, or ½" ODF.



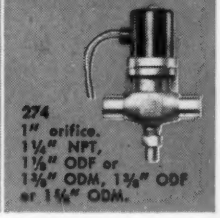
271 13/32" orifice. ⅜" or ½" NPT, ⅝" ODF or ⅞" ODM.



272 17/32" orifice. ⅜" NPT, ⅞" ODF or 1⅛" ODM.



273 ¾" orifice. 1" NPT, 1⅛" ODF or 1¼" ODM.



274 1" orifice. 1¼" NPT, 1⅜" ODF or 1⅝" ODM, 1⅜" ODF or 1⅝" ODM.

AUTOMOTIVE AIR CONDITIONING

For most cars. ⅜" inlet, ⅜" or ½" outlet. Internal or external-type equalizer. Pressure limiting 1½ ton, R-12. Factory-set superheat.

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230 Cap. ½-50 tons, R-12. ⅞" to 1⅜" ODF inlet. Removable orifice.

619 DEVICES

for refrigeration and air conditioning control and their full specifications are organized for quick reference in the newest CC catalog. Only the basic models are illustrated on this page. *You should have the whole catalog.* Write for CC Catalog W-5-S today to the address below.

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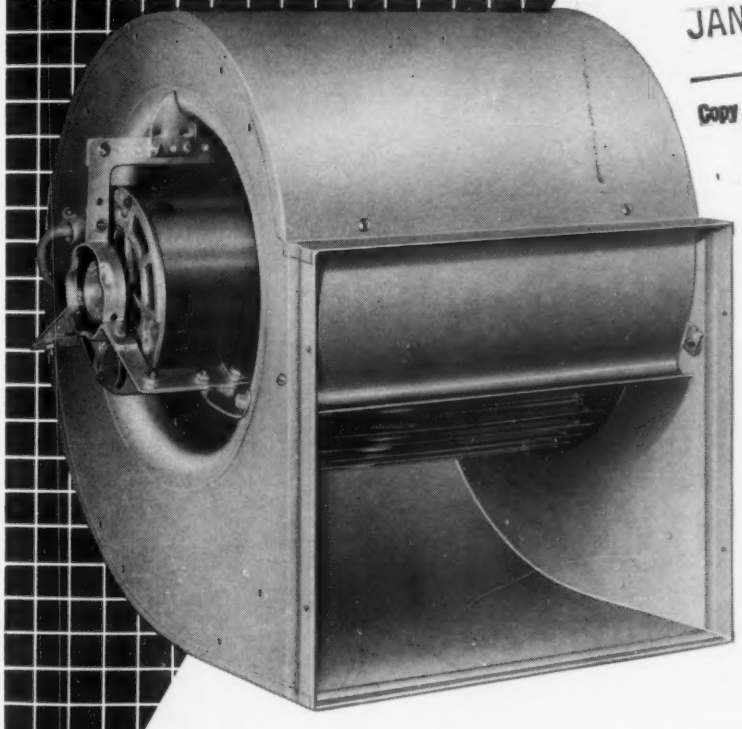
DIRECT DRIVE!

Another LAU "first in the Industry"

THE LIBRARY OF CONGRESS SERIAL RECORD
JAN 28 1960



The Lau direct drive blower is designed for efficient operation in the smaller, more compact heating and air conditioning systems. This unit is especially practical where space is at a premium and lower component cost is desired.

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JANUARY 1960

VOL. 2 NO. 1

OFFICIAL PUBLICATION

JOURNAL

Formerly Refrigerating Engineering including Air Conditioning, and incorporating the ASHAE Journal.

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Comment

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SOMEWHERE — OVER THE RAINBOW

"Man never is, but always to be blessed" wrote Alexander Pope, reflecting in his own way upon the old English tombstone admonition of "It's later than you think", now popular-songed for today's Age of Irresponsibility.

Be that as it may, the coming of a New Year ever brings with it a note of slightly hysterical optimism; for it is clear that all the soothsayers, wiseacres, pundits and seers know that everything is going to be all right.

Having attended a number of industry meetings in the latter part of 1959 we feel that, so far as the fields of activity of the members of ASHRAE are concerned, considerable optimism is indeed justified to the extent of available facts.

People continue to want, and will have, air conditioning to an increasing degree. More and more houses will be built requiring heating and cooling equipment. Commercial and office buildings follow the same pattern. Even outer space hardware yields to the trend. Refrigeration of the processing, transportation, warehousing and distribution of food is still in the explosively expanding stage.

Engineering must keep pace; always to anticipate Tomorrow's needs.

FROM THE SHADY SIDE

Call it conservation, caution or what you will, but there is the other side which may be considered at least quizzically. How long can we all continue to live "on the cuff"? How great a burden of consumer credits can be sustained? Will it be possible to expand indefinitely the philosophy of an economy of waste? What happens when all the possible ways to prosperity through stimulated spending have been exhausted?

"In the long run" retorted Lord Keynes, high priest of the spend-to-prosper cult when similarly questioned, "we shall all be dead."

True enough, but that is only one phase of the Age of Irresponsibility.

So, Happy New Year and a prosperous one, too.

ANOTHER NEW LOOK

Issue by issue, your ASHRAE JOURNAL acquires a realigned treatment of feature content, additional departmental material, a somewhat more relaxed method of presentation and stepped-up typography—including occasional four-color covers. All, to make it more attractive to more members.

Edward R Searles
Editor

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Engineering the temperature...

AROUND THE WORLD...

Bangkok, Thailand. In oppressive heat and sweltering humidity the luxurious Erawan Hotel is completely cooled by Recold air conditioning equipment. Horizontal and vertical air handling units cool the public rooms. Small RE room units, individually controlled, cool and dehumidify each of the 206 apartments and bedrooms.

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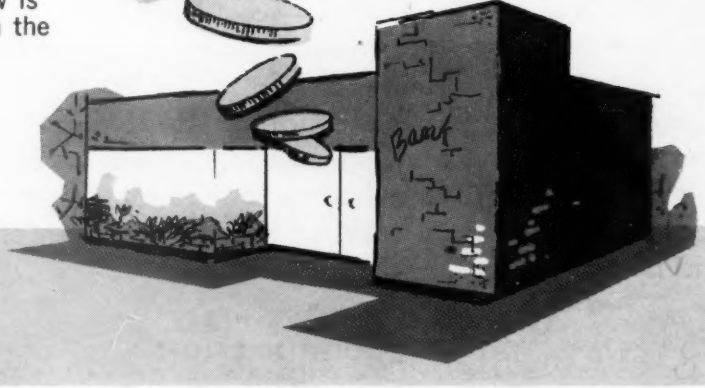
APRIL 30, PRACTICAL APPLICATIONS' DAY



For further information contact:
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TOO GOOD NOT TO BE TRUE

This skilled pair of hands belongs to a man who adheres strictly to the Viking tradition of quality. Like all his fellow workers, he is exercising great care to make absolutely certain that every last inch of Viking copper tubing meets your exact specifications.

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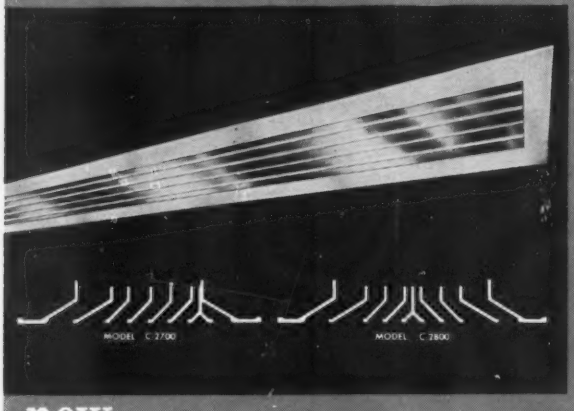
New



new Titus model C-2700 & C-2800 SLIM-LINE GRILLES designed for ceilings. 1-way and 2-way deflection models. Any length — many standard widths.

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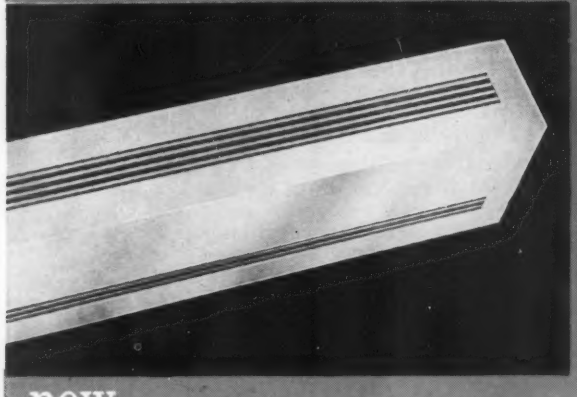
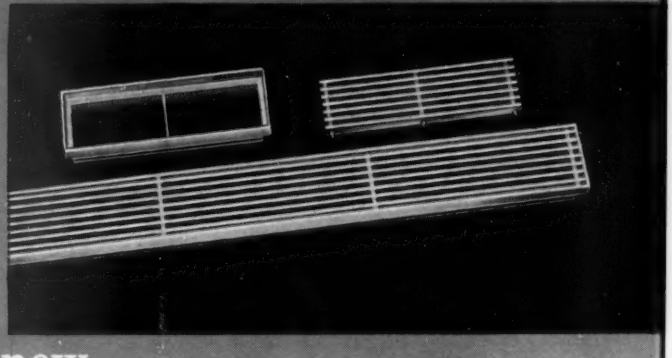
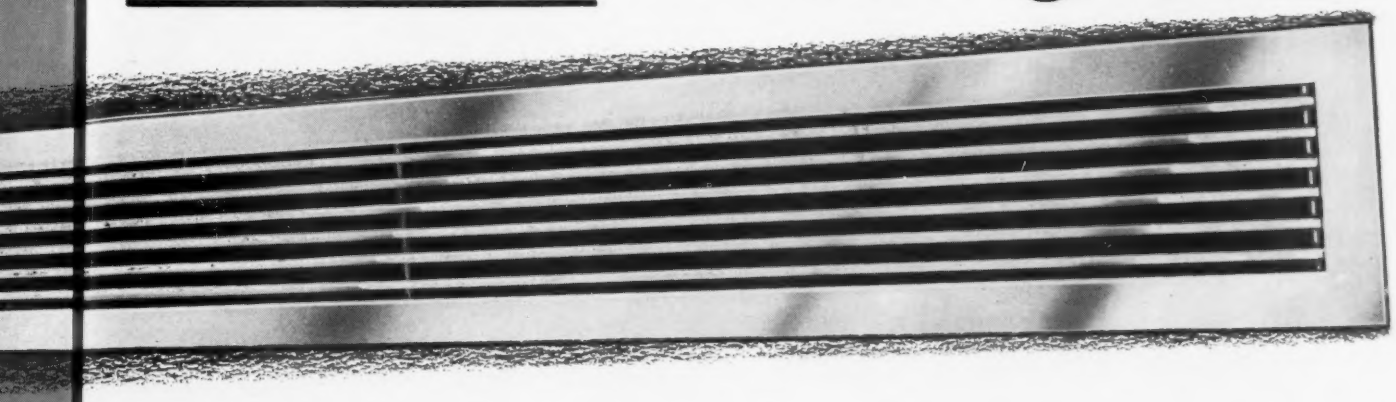


new Titus model C-3100 CONVECTOR ENCLOSURE. Today's most modern covering for convectors, radiators, air conditioning and ventilating units. Grille faces in top and side.



new Titus model 3000 FLOOR GRILLE WITH REMOVABLE FACE. Grille face lifts out of frame, then is replaced after frame is installed in floor. Any length, many stand. widths.

matched linear grilles



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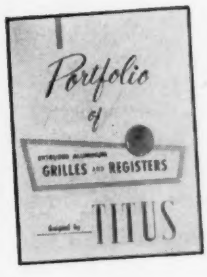
EXTRUDED ALUMINUM GRILLES



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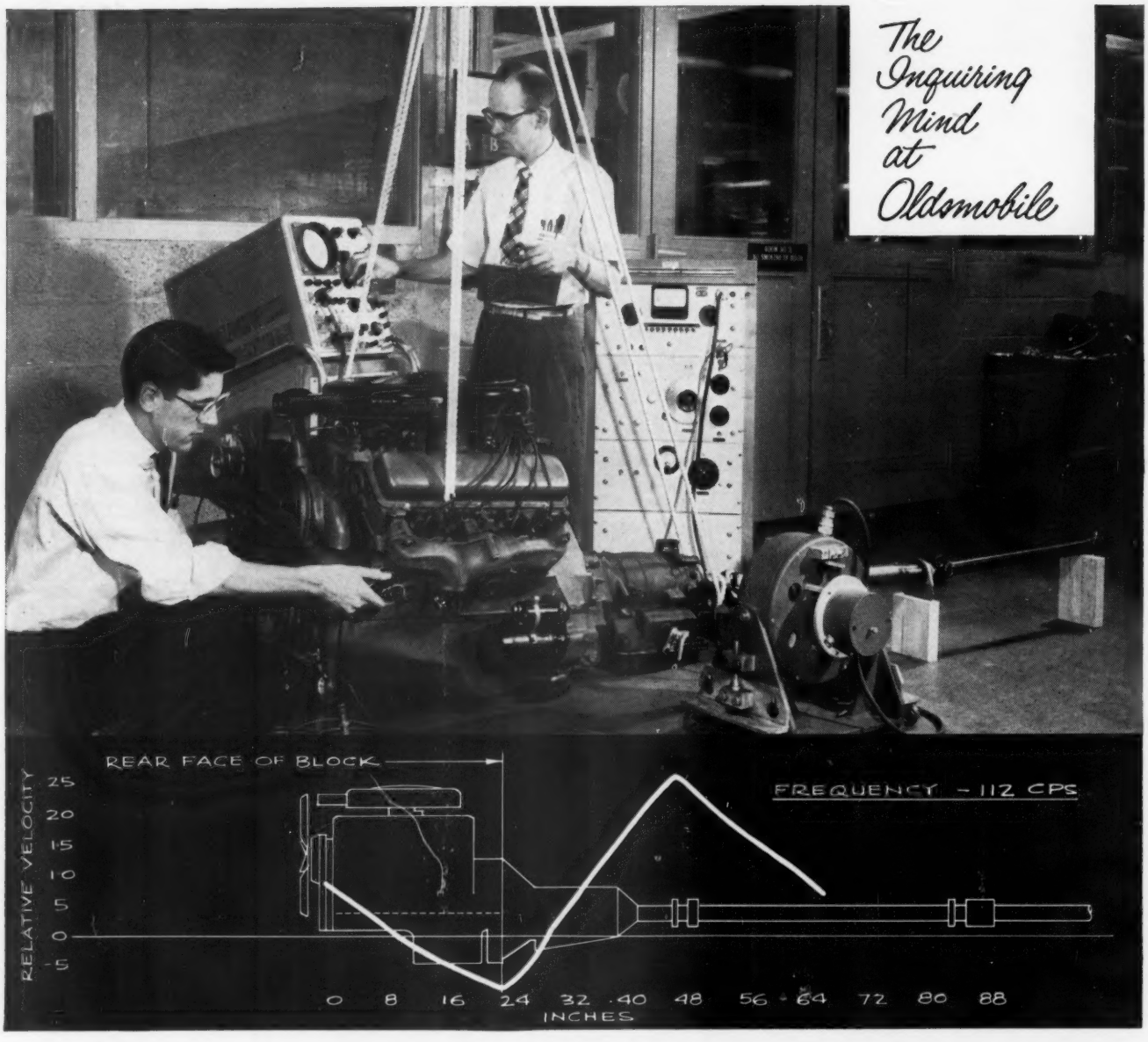

no. 11 OF A SERIES

SHAKE-DOWN TEST FOR A ROCKET!

Intricate vibration studies that determine proper engine mounting points help Oldsmobile engineers design smooth, balanced Rocket Engine power.

To tame the explosive fury of the modern high compression engine, Oldsmobile engineers have developed highly specialized techniques in the field of vibration studies. The results of these studies produce Rocket Engine power that is balanced, controlled and exceptionally quiet under nearly every operating condition. Vibrations caused by the multitude of explosions in the cylinders—600 per minute at 30 mph—are almost imperceptable in the passenger compartment.

To thoroughly study an engine's "bending" characteristics, in both horizontal and vertical planes, the engine is suspended from a low spring rate nylon rope that isolates external interference. A shaker is used to excite the entire power plant and drive line to find the resonant vibration frequencies, generally in the 25 to 55 mph speed range. Then intensive analysis of the engine begins. At four inch intervals, a transducer in contact with the engine translates movement into a reading on an oscilliscope. From this information, a displacement curve is plotted showing exactly the ideal locating points for the engine mountings—the "nodal points".

In addition, each engine accessory—generator, air cleaner, power steering pump, etc.—is studied so that no undesirable resonant vibrations will occur.

The quiet power, brilliant performance and solid quality of the 1960 Oldsmobile is a tribute to modern technology and craftsmanship. There's never been another car like it! Visit your Quality Dealer soon and Quiet-Test Olds for '60.

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4-pole ••• 4-cylinder ••• minimum space requirements ••• internal spring mounting for quiet, vibration-free operation ••• 2½, 3, 3½ and 4 H.P. ••• inherent motor-protector internally mounted, hermetically sealed ••• statically and dynamically balanced crankshaft ••• positive displacement gear oil pump, automatic reversing ••• heavy duty motor •••

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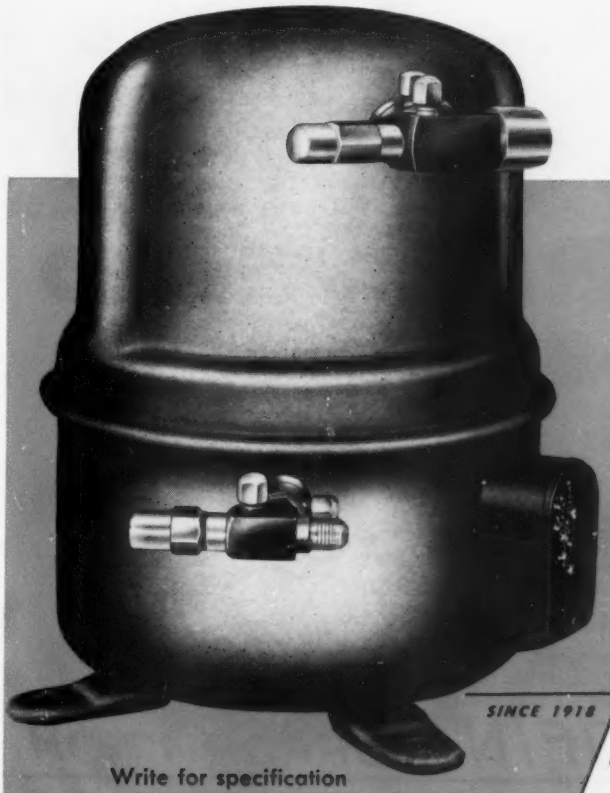
Your products deserve the best. Be sure to give serious consideration to the new Copelaweld "4U" series.



PERFORMANCE DATA

Model	Capacity* B.T.U./Hr.	Full Load Amps.	Locked Rotor Amps.
4U16-252	29,400	13.6	70
4U18-302	32,800	17.9	70
4U22-352	39,400	21.4	126
4U26-402	45,000	27.8	126

*Capacity based on A.S.R.E. rating conditions: Evaporating Temperature 45 F.; Condensing Temperature 130 F. Suction Gas Temperature 65 F.; No liquid sub-cooling.

Write for specification sheet number 5909

SINCE 1918 **Copeland** REFRIGERATION CORPORATION, Sidney, Ohio

CHICAGO SUN-TIMES

Naess & Murphy
Architects-Engineers

Field Enterprises, Inc.
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General Contractors

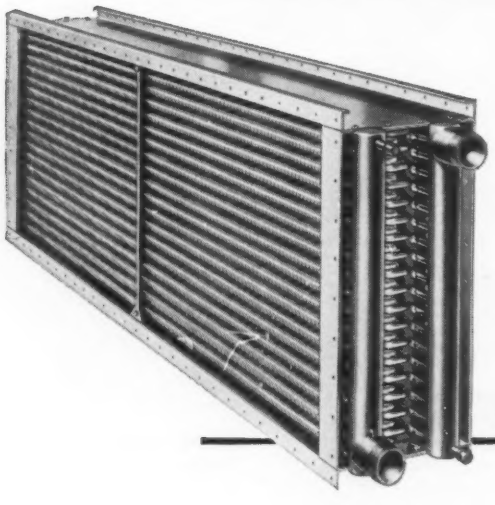
William A. Pope Company
Refrigeration Contractors

Kroeschell Engineering Co.
Heating Contractors

New completely air conditioned building ... last word in comfort and efficiency

Photo: Hedrich-Blessing, Chicago

AEROFIN INSTALLED



Aerofin's modern SMOOTH FIN design permits use of high air velocities without turbulence or excessive resistance — provides ample heat-exchange capacity in limited space.

You can safely specify Aerofin coils at full published ratings. Aerofin performance data are laboratory and field proved by the pioneers in light-weight extended surface.

AEROFIN CORPORATION

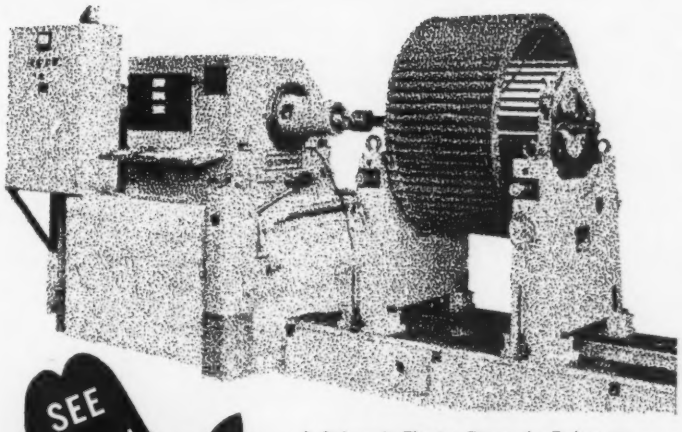
101 Greenway Ave., Syracuse 3, N. Y.

Aerofin is sold only by manufacturers of fan system apparatus. List on request.

ENGINEERING OFFICES IN PRINCIPAL CITIES

UTILITY FAN CORPORATION

WHY UTILITY MOVES AIR BETTER



SEE YOU IN DALLAS

A Schenck Electro-Dynamic Balancer will be featured in our Dallas display. See for yourself how UTILITY quality is engineered in!

ONE BIG REASON: All blower wheels are precision balanced on special equipment to insure quiet, long-lasting and trouble-free performance. The world's finest dynamic balancer, adapted to UTILITY specifications, is capable of determining center-of-gravity displacement as small as 25-millionths of an inch! And UTILITY uses it all day every day.

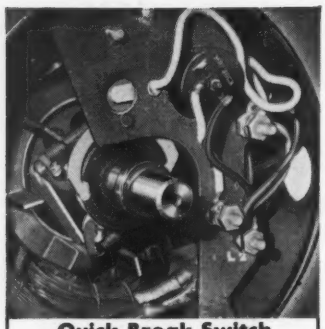
There are many more reasons for UTILITY quality. Let us tell you all about them soon.

UTILITY FAN CORPORATION
Division of Utility Appliance Corp.
911 East 59th Street
Los Angeles 1, California

NO STARTING PROBLEMS

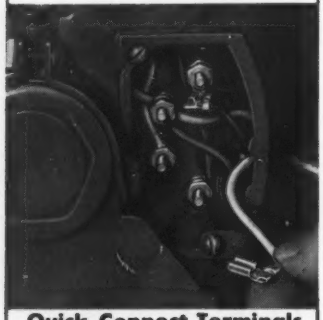
with

WAGNER CAPACITOR-START MOTORS



Quick Break Switch

The starting winding is disconnected from the line by this Wagner designed switch . . . test proved to make more than a million breaks. (That adds up to two starts per hour for 50 years!)



Quick Connect Terminals

Brass tabs on terminal studs permit quick, easy connection of leads . . . cut wiring time to speed assembly line production. Simply press the lead receptacle on to the stud—a positive connection is assured.

All-Angle Operation

The sleeve bearing design, in fractional hp ratings, has a positive lubrication system that permits operation in any position . . . can mean important savings in motor costs to manufacturers.

Pack more power into less space . . . give long troublefree service . . . are easy to hook up

Here are general purpose single-phase motors that have high starting torque and high pull-in torque. When used in the proper application and supplied with voltage close to their rating, they'll give positive starts every time. Troublefree operation is assured . . . thanks to the positive action of the Wagner governor mechanism and long life quick-break switch.

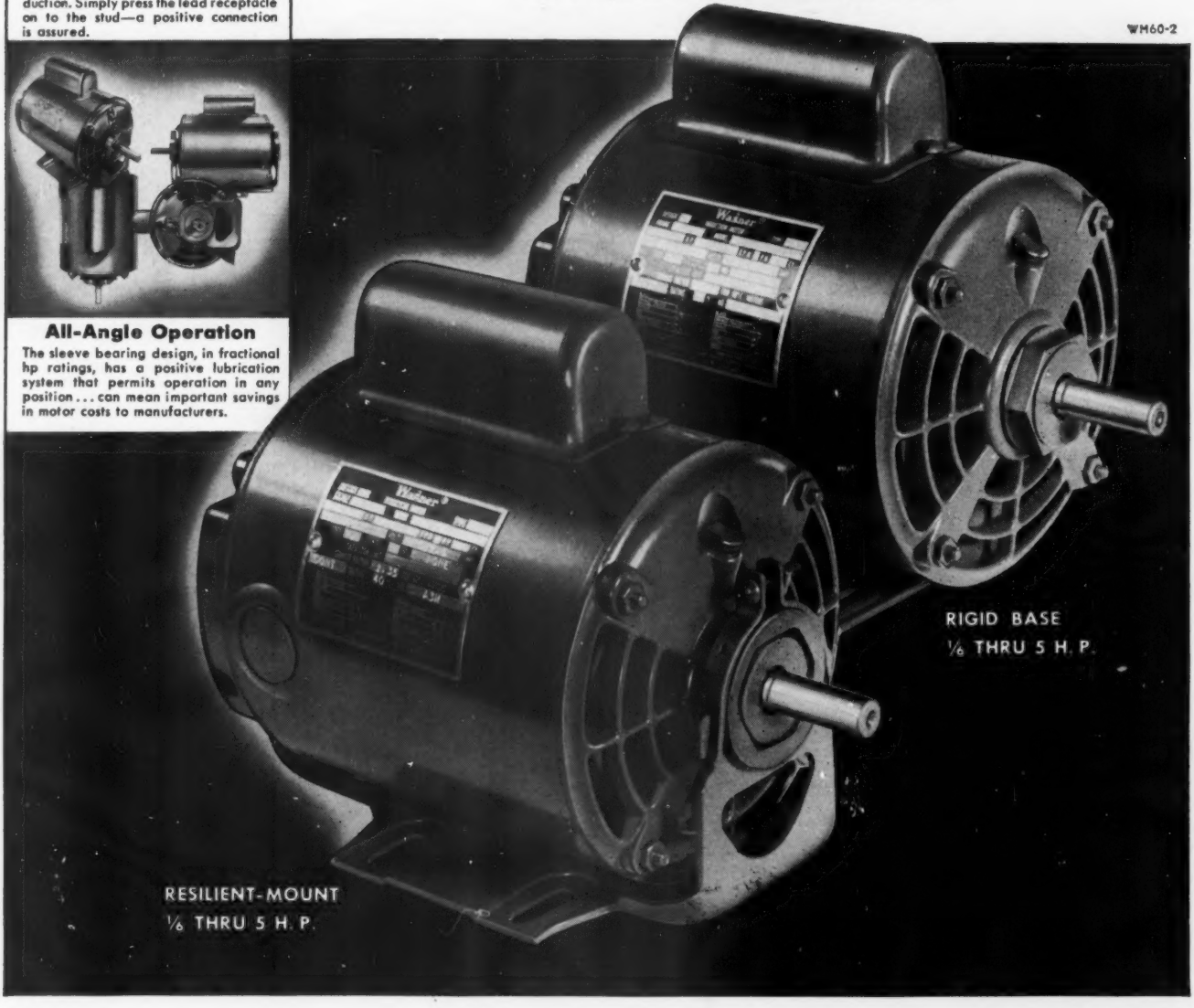
Wagner Type RK Motors pack more power into less space. Small enough to fit in tight spots, their ruggedness is built-in . . . permits direct mounting. They are available in a range from ⅛ through 5 horsepower, with sleeve or ball bearings, and with rigid bases or resilient mountings. And, sleeve bearing fhp models can be operated in any position.

Get these motors from leading distributors in your city, or from Wagner Sales Offices in 32 cities across the country. Your Wagner Sales Engineer will be glad to help you select the right motor for your application. Wagner Bulletin MU-217 gives full details on Capacitor-Start Motors.

Wagner Electric Corporation

6379 Plymouth Avenue, St. Louis 33, Missouri

WM60-2

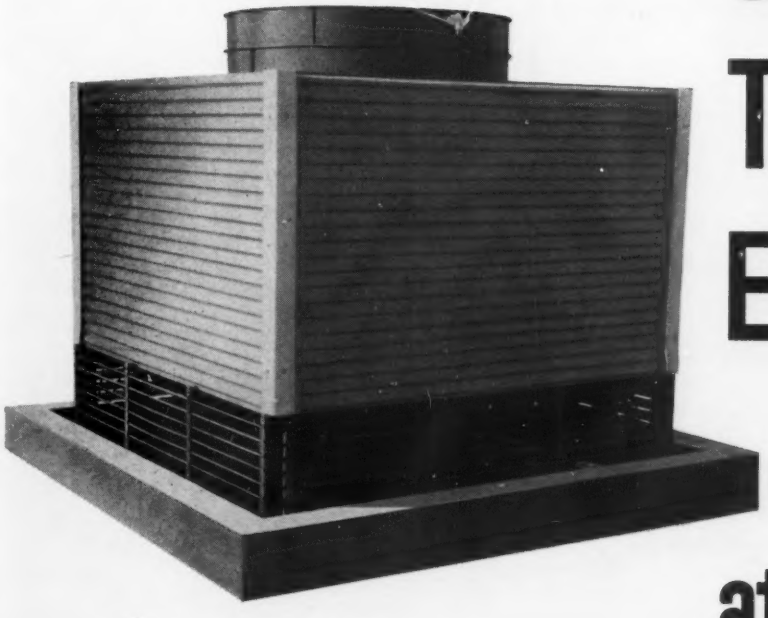


FLUOR

OVER 40 YEARS OF COOLING TOWER EXPERIENCE

at your service *

* Since 1919 Fluor has been building cooling towers throughout the world. (An average of one new industrial or commercial cooling tower is erected by Fluor every three days.)



Ask for our brochure that shows why Fluor Towers mean more efficient operation.

See our exhibit in Dallas at the 2nd Southwest Heating and Air Conditioning Exposition February First to February Fourth.

Fluor PRODUCTS COMPANY

AIR CONDITIONING AND REFRIGERATION COOLING TOWERS

A division of The FLUOR CORPORATION, Ltd.

GENERAL OFFICES:

SANTA ROSA, CALIFORNIA

SPORLAN FAMOUS FIRSTS

...Thermostatic Expansion Valves

1934 Selective Charges

1934 Replaceable Power Element

1934 Replaceable Parts

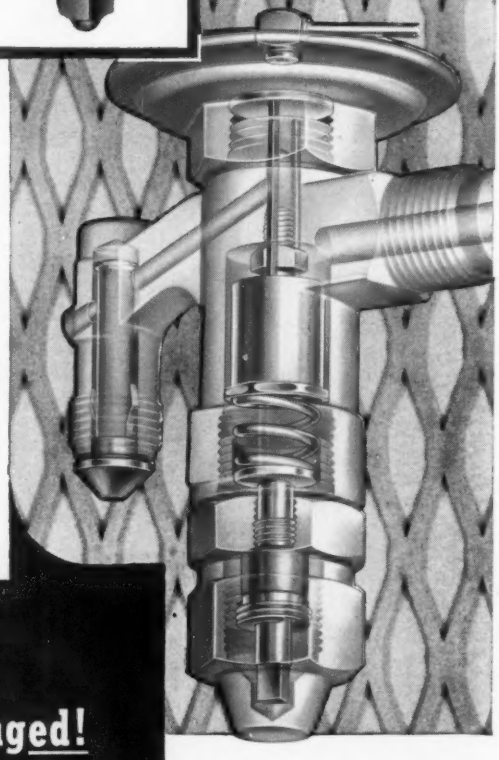
1934 Solder Flange Bushings

1935 Flat Welded Diaphragm

1948 Flow Master Element

1951 Level Master Control

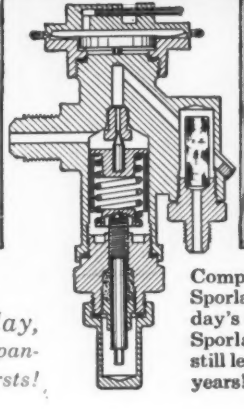
Modifications will always be made, but always to improve the product . . . . never to change it!



Basic in design . . .

Constantly Improved . . . but never changed!

Send for Bulletin 10-10 today, then order Sporlan Thermostatic Expansion Valves with all these famous firsts!



Compare this original Sporlan design with today's phantom above. Sporlan's basic design still leads after all these years!

SPORLAN VALVE COMPANY

7525 SUSSEX AVE. ST. LOUIS 17, MO.

Export Dept. 85 Broad St., New York 4, N.Y.

Late news highlights

Free piston refrigeration Practical application of the free piston compressor (ASHRAE JOURNAL, November 1959), as described by Messrs. McCrory, McNinch and King at the ASHRAE Lake Placid Meeting last year, seems imminent. Robertshaw-Fulton Controls Company has announced that negotiations concluded with the sponsoring Battelle Memorial Institute granted the exclusive license to manufacture such units in sizes up to 20-ton capacity.

Thermal insulation Comprehensively reviewing *Industrial Thermal Insulation* at the text book level, Allen C. Wilson has compiled a study of principles, economics, materials, applications and specifications. 296 pages, $9.00. McGraw-Hill Book Company, 330 West 42nd Street, New York, N. Y.

College-industry As host to the Relations with Industry Div of the American Society for Engineering Education, the Engineering School, Washington University (St. Louis) will bring together leaders of education and industry at the 12th Annual College-Industry Conference, January 27-28.

Scientific activities Third in a series describing the policies and procedures of Federal agencies relative to their scientific and technical information activities, a report of the National Science Foundation (Washington 25, D. C.), November 1959, includes references to the Office of Technical Services, Bureau of the Census, Bureau of Public Roads and Patent Office.

Patents As an informational aid for inventors, the United States Department of Commerce, Patent Office, Washington 25, D. C., has compiled a 26-page reference, *Patents & Inventions* (15c) which gives a step by step review of patenting procedures and includes a group of those most frequently asked questions about patents together with authoritative answers.

Pro wall-type As the result of a survey of 1000 builders of apartment or garden type buildings it develops that 80 per cent prefer through-the-wall air conditioning in comparison with other forms and will use them in construction planned or under way for the next 12 months. Of the other systems, 12 per cent favored central air ducts, 7 per cent central chilled water systems and one per cent window air conditioners. Almost 95 per cent of these builders are planning to provide some form of air conditioning. Fedders Corporation survey.

18 for 12 Fulfilling the promise inherent within "Permeability of Plastics Films to Refrigerant 12 and Nitrogen," a paper by duPont's H. M. Parmelee at the ASRE 44th Semiannual Meeting in Chicago (REFRIGERATING ENGINEERING, February 1958), the Hotpoint Div of General Electric has announced an 18-cu ft household refrigerator occupying the same space as 12-cu ft predecessor models and insulated with a kraft paper and Saran-polyethylene envelope containing a halogenated hydrocarbon refrigerant.

Chemical industry Within the 164 pages of the Fourth Edition of the *Chemical Industry Facts Book* (Manufacturing Chemists' Association, 1825 Connecticut Avenue, N.W., Washington 9, D. C.) appear historical, industry, utility, application and statistical facts regarding chemicals of all kinds.

Our error On page 65 of the December 1959 issue of the ASHRAE JOURNAL, wherein were listed the current nominations for elections to the ASHRAE Board of Directors, to be voted upon at the forthcoming Dallas Meeting, we inadvertently interposed the biographical paragraphs of James H. Downs and L. K. Warrick. Our regrets, gentlemen.

Practical air conditioning Starting with theory and basic physics and proceeding rapidly to practical applicational considerations, Norman C. Harris has authored *Modern Air Conditioning Practice.* 364 pages, $6.75. McGraw-Hill Book Company, 330 West 42nd Street, New York, N.Y.

Frozen foods Sponsored by The Refrigeration Research Foundation, the Second Regional Educational Seminar for key operating personnel in the refrigerated warehousing industry will be held January 28-29 in Chicago.

BRAB publications Offered as the first complete and comprehensive listing to have been prepared of the various publications of the Building Research Advisory Board, 2101 Constitution Avenue, Washington 25, D. C., a recently issued booklet provides title, subject, price and review references.

New name Effective January 1, the former Humidifier Association became the National Humidification Association. George Boeddener has been named Executive Vice President. Headquarters remain in Cleveland, Ohio.

$200,000 of help To assist the new cooperative program for graduate study and basic research for the University of Cincinnati, the Ford Foundation has provided a $200,000 five-year grant. Specifically, this will cover faculty appointments and related expenses.

About piping Within the 416 pages of the *Pipefitters Handbook,* $6.00, are reviewed essentially all techniques and procedures allied with piping for various purposes. This Second Edition has added chapters and extended tabulations and dimensional data. Industrial Press, 93 Worth Street, New York 13, N. Y.

Meteorology To meet the needs of those who use climate facts, a six-volume series of tabulated data has been prepared. Part III, the last to be published, covers Europe and the North Atlantic above 35°N. *Tables of Temperature, Relative Humidity and Precipitation for the world.* $2.52. British Information Service, 45 Rockefeller Plaza, New York 20, N. Y.

Hire whom? Offered as a universally applicable guide for the recruiting of engineering college graduates, the American Society for Engineering Education, University of Illinois, Urbana, Ill., has just issued *Recruiting Practices and Procedures,* 10c.

Europeans prefer French and German consumers in the European Common Market consider American air conditioning and refrigeration the best available, a study by the Opinion Research Corporation reveals. The research project, which consisted of interviews with 735 persons, showed that those questioned were favorably impressed by the quality and "practical and pleasing" packaging of American products, although there was some criticism of styling and poorly-finished products.

Refrigerant guides in space Refrigerant 14 is used along with nitrogen to guide the positioning of the final stage of the Discoverer satellite. Thrust from tiny reaction jet nozzles alters the attitude of the satellite in space.

Contrary to the information provided by the Travel Arrangements enclosure, as mailed to ASHRAE members with the announcement of the Dallas Semiannual Meeting, there will be no trips scheduled during the meeting. Thus, those wishing to make post-meeting trips to Mexico may do so but there will be no trips February 1-4.

Now!

this golden cap identifies "Freon" premium quality refrigerants*

"Freon" Products Division
E. I. du Pont de Nemours & Company (Inc.)
Wilmington 98, Delaware

DU PONT
REG. U.S. PAT. OFF.

Better Things for Better Living
. . . through Chemistry

factory sealed for purity by Du Pont

Gold-capped cylinders—the new way to identify "Freon" premium quality refrigerants. Each gold-capped cylinder of "Freon" is *factory-sealed* by Du Pont to make sure you get the high purity guaranteed by 27 years of manufacturing leadership.

Today "Freon" is so dry and pure that the published specifications for "Freon" refrigerants are the accepted standards of quality for the entire industry. Best of all, "Freon" costs no more than refrigerants that are supposed to be "just as good". So *insist on "Freon"*—the time tested, premium quality refrigerants—now identified by cylinders with the new gold colored hood cap.

FREON®
premium quality
refrigerants

*Freon and combinations of Freon- and F- followed by numerals are Du Pont's registered trademarks for its fluorinated hydrocarbon refrigerants.

Ranco Offers NEW COMMERCIAL CONTROLS for you to specify...

New Double Pole "O" Type Switches

Have wide product application for commercial refrigeration and air conditioning equipment

New double pole, single throw "O" Type Commercial Controls by Ranco are designed for a variety of two pole switching jobs—provide a double break for single-phase operations, simultaneous switching of two circuits, or switching two lines of a three-phase circuit. Available in Single Unit Models for low pressure, high pressure and temperature; and in Dual Models for dual pressure or dual temperature. Controls handle one, two and three-phase motors of ½ through 5 hp.capacity. Safety (High) limit stop may be added to the range screw on the high pressure side of a Dual Pressure Control, or to a Single Unit Control that cuts out on rise in pressure or temperature. Contact your local Ranco wholesaler —or Ranco Incorporated, Columbus 1, Ohio, for more details.

020 SINGLE UNIT CONTROL (Above)
Standard switch action. Contacts open on decrease in pressure or temperature.

021 SINGLE UNIT CONTROL (Not Shown)
Reverse switch action. Contacts open on increase in pressure or temperature.

Manual reset is available on both 020 and 021 Single Unit Controls.

022 DUAL UNIT CONTROL (At Left)
Combines high pressure with either low pressure or temperature. Both sides operate automatically—or manual reset may be added to either high pressure side only, or to both low and high pressure sides.

To Servicemen: Procure Ranco Service Manual No. 1660 from your Ranco wholesaler. It lists "O" Series Controls; covers nearly 5,000 other Ranco replacement applications. *(Not available from the factory.)*

Ranco®
INCORPORATED
COLUMBUS 1, OHIO

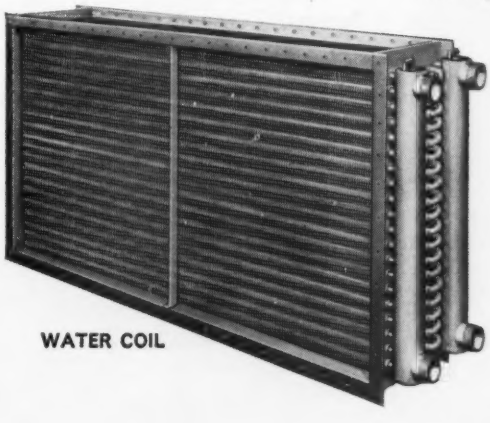
McQuay gives you...

STANDARD COILS · CUSTOM COILS

to meet any requirement and any design load

When you think of coils, think first of McQuay with the years of research and know-how which has made McQuay the nation's leading coil manufacturers. McQuay gives you the exclusive Ripple-Fin coils with tubes pressure expanded into wide, full fin collars to provide a permanent bond . . . actually forming a tube within a tube for maximum heat transfer. McQuay coils are made in 5/8", 1/2" or 3/8" tube diameters, one to twelve or more rows, and in the widest possible range of styles or capacities, with a choice of from one to fifteen fins per inch for maximum heat transfer efficiency and to permit accurate balancing of capacities with the design load. They are available for steam, hot water, cold water, direct expansion and refrigerant condensing, and can be made of any required or desired metal or combination of metals. When you specify McQuay you have selected the very best. For information on any coil requirement, call your McQuay representative, or write McQuay, Inc., 1606 Broadway Street N. E., Minneapolis 13, Minnesota.

one to 12 rows deep
one to 15 fins per inch



WATER COIL

DIRECT EXPANSION COIL

McQuay Means Quality

McQuay INC.

AIR CONDITIONING • HEATING • REFRIGERATION

PARTS and PRODUCTS

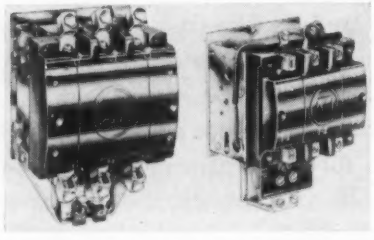
PACKAGED REFRIGERATION

Portable, packaged, remote supplies of low temperatures to −120 F are provided by the Kold-Pak, a one-piece mechanical refrigeration assembly. Either of the direct expansion or brine chiller type, the units are available in 12 standard models with a capacity span of 3240 to 34,000 Btu/hr at 40 F brine temperature or −60 F evaporator temperature and 660 to 7000 Btu/hr at −100 F brine temperature or −120 F evaporator temperature.

Tenney Engineering, Inc., Union, New Jersey.

MAGNETIC CONTACTORS

Designed to meet the control requirements of a wide range of air conditioning applications, two new Type B magnetic contactors have been in-



troduced. Both models carry 240 and 550 volt ratings. Available in 30 and 40-amp types with two, three or four poles, the larger model is suitable for most commercial and residential compressor applications up to and including 10 hp, while the smaller model comes in 25-amp, with two or three poles.

Arrow-Hart & Hegeman Electric Company, 103 Hawthorne St., Hartford 6, Conn.

INFRA-RED HEATERS

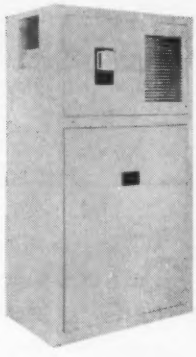
Particularly useful for heating high-ceilinged buildings, parabolic reflector units can be mounted at heights up to 45 ft, since the reflector concentrates and directs the rays. Straight

side reflectors, recommended on units mounted at heights from ten to 20 ft, provide a spread pattern of radiation. Ranging in output from 12,000 to 48,000 Btu/hr the thermostatically-controlled heaters make possible heating even large monitor and saw-toothed roofed factories, warehouses and garages without ducts, blowers or heat exchangers.

Perfection Industries, Div of Hupp Corporation, 1135 Ivanhoe Rd., Cleveland 10, Ohio.

AIR-COOLED CONDITIONER

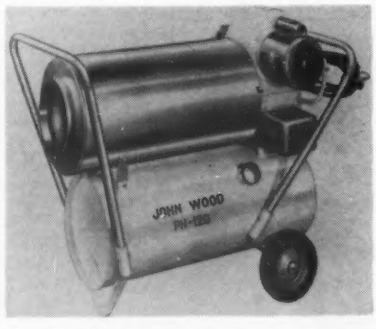
Developed for mobile, shipboard, airborne or stationary use, this self-contained unit, designated MAC-7½, has been released for use in military electronics. Included in design of the air conditioner are such features as extreme temperature operation (125 to −65 ambient), permanently lubricated bearings, automatic temperature control, cycling or non-cycling operation and built-in electric heaters.



Airflow Company, 400 S. Stonestreet Ave., Rockville, Md.

PORTABLE HEATER

For heating buildings under construction, curing or drying concrete, and



other such temporary or emergency heating jobs, Model 120 needs no vent and is equipped with a fold-back stainless steel combustion chamber to minimize odor, smoke and visible flame. Producing 120,000 Btu/hr, it will burn kerosene, #1 or #2 Diesel or fuel oil. The 1/6 hp motor takes 115 volt 60 cycle ac.

John Wood Company, Conshohocken, Penna.

VOLTAGE REGULATOR

Using rate feedback and zener diode sensing, this regulator has static components cited as eliminating tubes, brushes and other moving parts. Rated one kva, single-phase, zero to 8.5 amp, 120 volt, the Sta-Vo-Trol regulator maintains ±0.25% band width accuracy for a constant power factor load.

General Electric Company, Pittsfield, Mass.

SMALL LOUVER

Added to this manufacturer's line is a one-piece midget louver for all general uses. Grill openings are cited as being smaller than regular screening, eliminating the necessity of an additional screen unit.

This new line, designated the RLS series, is practical for outdoor installation, and is made of anodized aluminum. Six sizes are available: 1, 1½, 2, 2½, 3 and 4 in. diam.

Midget Louver Company, 6 Wall St., Norwalk, Conn.

1960 AIR CONDITIONERS

Produced in four different series ranging from one to two hp, this line includes the compact Ruler series, cited as being capable of installation in less than a minute. These units have permanent molding across the top and bottom and an attached accordion-type mount that enables the air conditioner to be placed in windows up to 35 in. wide.

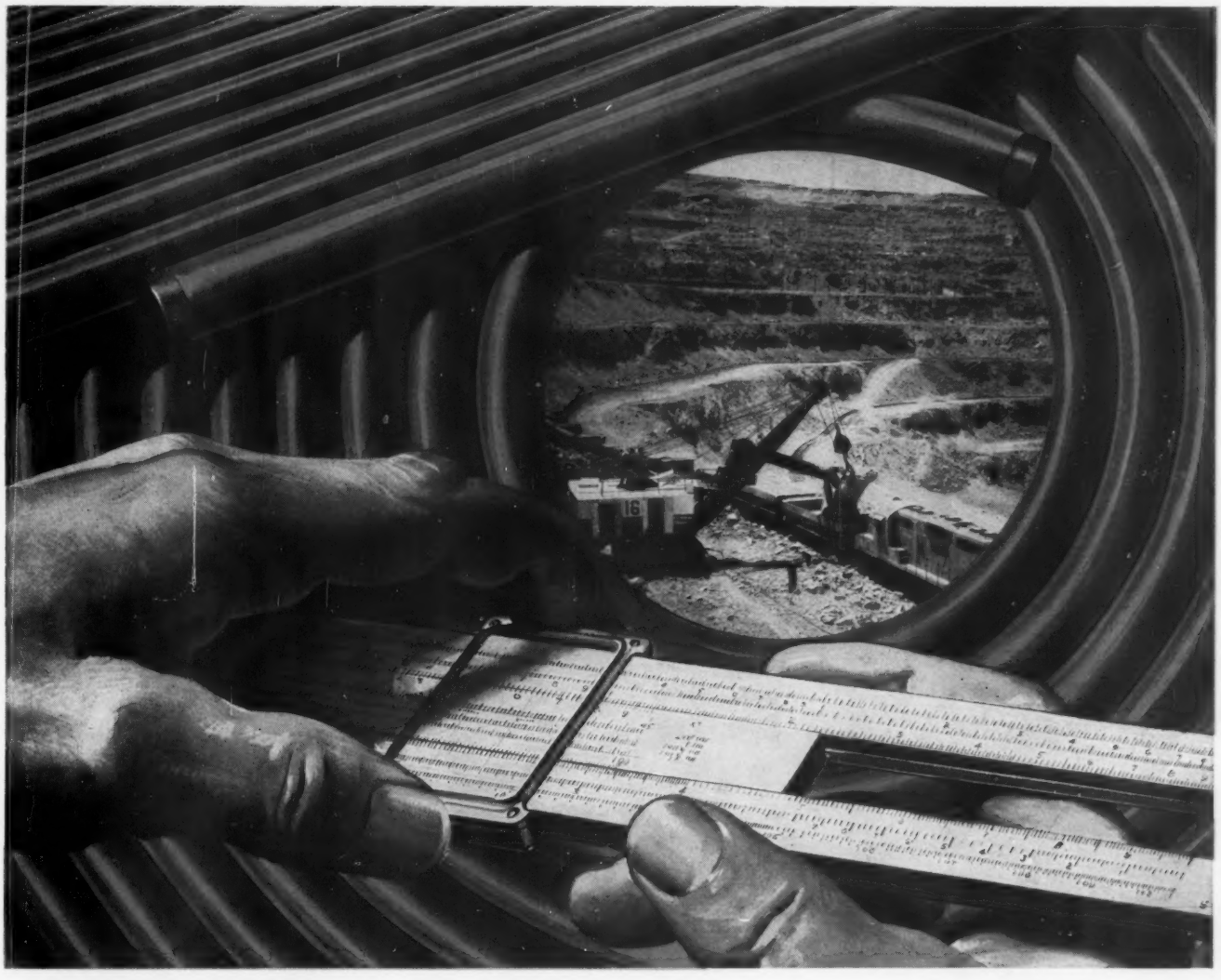
Official cooling capacity of each of the 11 models is indicated on the nameplate in Btus. All models have permanent aluminum mesh filters, a thermostat and new 360 deg adjustable air flow louvers.

Admiral Corporation, 3800 Cortland St., Chicago 47, Ill.

PRESSURE GAUGES

Most sensitive of this series of electrical instruments for determination of differential pressure of air and other gases has a full scale range

from zero to 0.01 in. water and detects pressure differences as small as



HERE'S WHY SO MANY ENGINEERS SPECIFY

Phelps Dodge Copper Tube for refrigerating, air conditioning and heating units!

1 Phelps Dodge has complete control of its copper tube from original source to finished product. The copper used in Phelps Dodge tube comes from Phelps Dodge-owned open-pit mines, is smelted in Phelps Dodge refineries and fabricated in modern Phelps Dodge mills. This overall Mine-to-Market control is assurance of highest quality and finest workmanship.

2 Phelps Dodge devotes particular attention, throughout fabrication, to uniform anneal for tube flaring and careful control of die draw for close tolerance.

3 Phelps Dodge can supply maximum tube lengths and precise wall thicknesses engineered to customer specifications; straight length tube tempered to meet bending and expanding requirements.

4 Phelps Dodge multiple mill operation guarantees a steady source of tube supply to meet the needs of manufacturers of refrigerating, air conditioning and heating equipment.

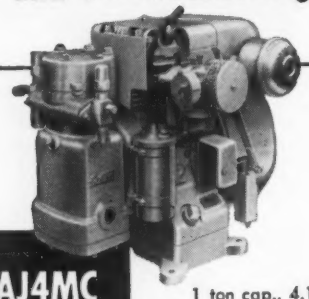
It's the famous Mine-to-Market Quality Line . . . sold the quality way—through authorized wholesalers!

PHELPS DODGE COPPER PRODUCTS

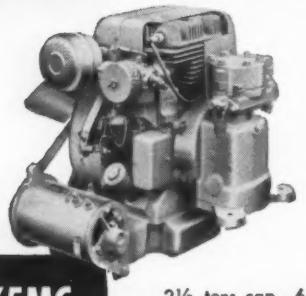
CORPORATION

New York, N.Y. • Los Angeles, Calif.

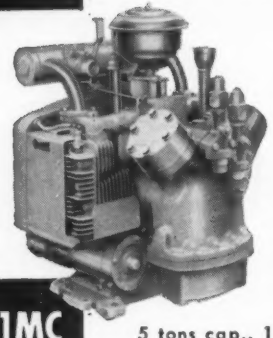
Onan
ENGINE COMPRESSORS
for mobile refrigeration and air conditioning



AJ4MC 1 ton cap., 4.1 H.P., F-12 refrigerant.



LK5MC 2½ tons cap., 6.25 H.P., F-22 refrigerant.



CCK11MC 5 tons cap., 12.9 H.P., F-22 refrigerant.

Built as integrated in-line units with Onan engines direct-connected to Onan compressors. Compact, permanently-aligned and smooth-running. No troublesome belts, couplings or sheaves. Optional accessories: batteries, starters, generators, and fans. Onan 4-cycle engines, built for continuous duty and long life, operate on either gasoline or Propane. World-wide parts and service organization.

Onan ELECTRIC PLANTS

Write for complete engineering data

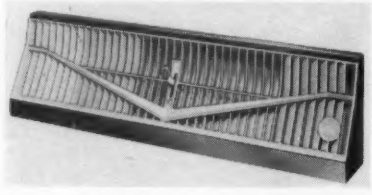
D. W. ONAN & SONS INC.
3431 University Ave. S.E., Minneapolis 14, Minn.

0.0001 in. water. Other models have a full scale range from zero to 0.03, 0.1, 1.0, 3.0, 10, 20, 50 and 100 in. water.

These differential pressure indicators are electrically operated on 115 volt, 60 cycle ac, and the sensing device is a noble metal thermopile installed in a flow tube. Since the instruments also compensate for changes in pressure and temperature of the air or gas, they can be calibrated directly in terms of mass flow if desired. They were especially designed for those applications where the user needs to accurately determine pressure difference in a specific range for production testing, quality control and product design.
Hastings-Raydist, Inc., Hampton, Va.

AIR DIFFUSER

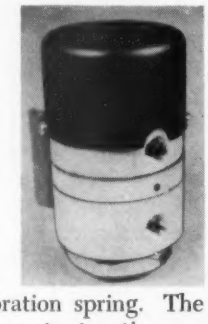
An 18 in. diffuser with a polystyrene face cited as not cracking, rusting or



able to be marred, the Super 38 has 38 sq in. of free area. Air pattern of the unit is wide-spread, diffusing and close-to-the-wall. Its face is easily removed and replaced; the diffuser may be installed on the sub-floor and plastered into the wall if desired.
Air Control Products, Inc., Coopersville, Mich.

REVERSE RELAY

Pneumatically-controlled air conditioning, heating and ventilating systems are cited as being given fail-safe protection in case of air line failure with a compact reverse relay, the Type 783. Converting normally-closed pneumatic equipment to normally-opened operation, the relay is an auxiliary device which performs this operation gradually. When air pressure falls to zero, the equipment reverts to its normally-closed operation and shuts down.



Operating on a force-balance principle, the relay balances the pressure of supply and exhaust air against a calibration spring. The fixed 1:1 input to output ratio produces a one psi change in return pressure for each psi change in thermostat pressure.

Normal supply pressure is 15 psi, with a maximum supply pressure of 25 psi. Maximum and minimum temperatures are 160 and –20 F, respectively.
Powers Regulator Company, 3434 Oakton St., Skokie, Ill.

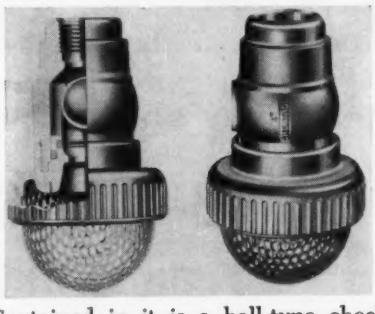
HEATING UNIT THERMOSTAT

Small (25 amp) bi-metal thermostats installed in the top leading edge of Electrofin convection baseboard heaters, as shown, disconnect the power circuit should heater temperatures rise abnormally from any cause. Spaced

approximately 20 in. apart, these thermal cutouts are wired in series with the heating elements.
Berko Electric Manufacturing Corporation, 212-40 Jamaica Ave., Queens Village 28, N. Y.

PLASTICS FOOT VALVE

Designed to be used in sumps, tanks, etc., where fluid level must be reduced or fluid completely withdrawn, this foot-valve is of all-molded plastics construction and is completely inert to corrosion and corrosive influences.



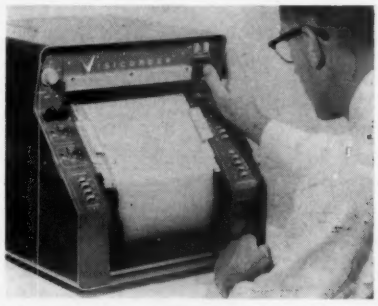
Contained in it is a ball-type check valve preventing back flow and on the suction end is a hemispherical plastics screen protecting against intake of debris.

Furnished in a full range of sizes from ½ through two in., the model shown can be had in Types I and II PVC. Connectors are available in IPS threads or in standard socket dimensions for solvent welding.
Chemtrol, 10872 Stanford Ave., Lynwood, Calif.

24-CHANNEL OSCILLOGRAPH

Allowing direct recording of up to 24 channels of high-frequency, high-sensitivity information from dc to 5000 cps, the 1108 Visicorder is a dry and dustless oscillograph. Light source for the recorder is a high-pressure mercury vapor lamp with maximum output in the ultraviolet region. This,

combined with a specially-designed optical system and record paper with maximum sensitivity to ultraviolet radiation, produces immediately read-



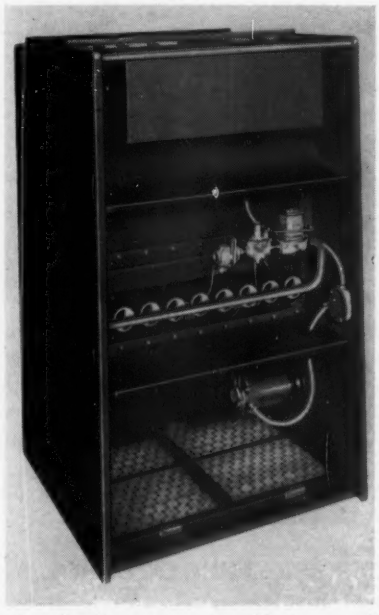
able records. Chart speeds, which are adjustable in 15 variations from 0.05 to 80 in. per sec, are pushbutton-selected.

Minneapolis-Honeywell Regulator Company, Heiland Div, 5200 E. Evans Ave., Denver 22, Col.

GAS-FIRED FURNACES

Completely assembled and wired at the factory, two furnaces, of 175,000 and 200,000 Btu input, added to the Moncrief line are quite compact in relation to their large capacities.

Heat exchangers of the units are constructed of die-formed 16-gauge end-welded steel sections. Twin 10-in. blowers, mounted on the same drive shaft, provide air for heating and any increased air deliveries required for cooling. Standard air intake is through the bottom of the furnace, with adap-



tation for basement installation made by means of an optional accessory return air cabinet or side filter frame.

Henry Furnace Company, Medina, Ohio.

150-TON COOLING TOWER

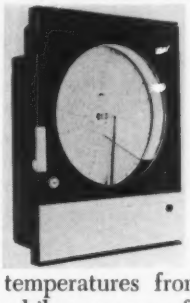
Now available in standard production is the largest unit in this line of cooling towers, a 150-ton vertical discharge unit. Designed with a compact, low silhouette, the EC-150 is made only in 10-gauge. Low speed, large diameter fans provide quiet operation, with air inlets at both ends.

Halstead & Mitchell, Zelienople, Pa.

REDESIGNED RECORDER

Forerunner of a line which will include control models, the 12-in. recorder here illustrated can be provided with up to four recording pens, for temperature, pressure, or a combination of the two variables.

Featuring a redesigned exterior, the recorder has a recessed bottom per-

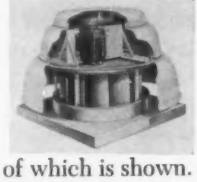


mitting one type of connection for both wall or panel mounting. Ball-pivoted pen movements minimize friction and wear. Filled-system thermometer elements measure temperatures from −300 to 1200 F, while pressures from 30 in. of mercury vacuum to 25,000 psi can be recorded.

U. S. Gauge Div, American Machine & Metals, Inc., Sellersville, Pa.

LOW CONTOUR VENTILATOR

Twenty-five basic selections of top speeds and capacities in direct drive models and 64-in. belt drive models, with hp ratings from 1/60 to 7½, provide capacities from 65 to 27,648 cfm in this line of centrifugal fan



roof ventilators, one of which is shown. Designed especially for exhausting air from schools, churches, hospitals and other areas where roof mounting of a low contoured unit is desired, these ventilators feature heavy gauge spun aluminum housings. Motors and drives are on oversized resilient mountings and in separate compartments out of the air stream.

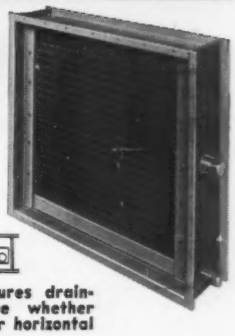
Burt Manufacturing Company, 44 E. South St., Akron 11, Ohio.

CHECK VALVE

Having wide application in all types of hydraulic and pneumatic systems, this valve is designed to allow full flow at operating pressures up to 3000 psi, with a minimum pressure drop, and to provide quick opening and positive closing. Compact in design and light-weight, it is available in standard sizes for ¼ to 2-in. tube connections. A technique incorporating a seal ring with a dual-seating action is used to provide a leak-proof

REMPE
Heat Transfer Equipment

HEAVY DUTY
STEAM COILS
Distributor Type



Tilted feature assures drainage of condensate whether used for vertical or horizontal air flow.

Non-Freeze Design

Every square foot of face area produces equal heating capacity on full or modulated steam supply. Suitable for pressures to 200 lb. gauge.

Two row or one row available. Can be furnished with connections as shown or on opposite end of coil.

Write for Details

Rempe

TANK and COIL ASSEMBLIES

For Sub-Zero or High Temperatures

One of many Rempe Coil jobs: This Tank and Coil assembly was built for use with thermostatic expansion valves to dewax oil at minus 35° F. Any diameter or any length to your specifications or our design. Can be supplied in Steel, Alloy, Stainless Steel, Copper or Aluminum.

Engineering Data Book
Pipe Coil and Fin Coil Designs. Heat Transfer Coefficients. Get a copy for your library.

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362 N. Sacramento Blvd. • Chicago 12, Ill.

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Activated Charcoal
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Activated charcoal acts as a positive molecular sponge which adsorbs gases, vapors, irritants, toxic substances and smog. It enables you to engineer for high percentage air recirculation at low cost.

These and many other bulletins on all applications of activated charcoal are available to you. Give us the details of your application and we will supply specific data and samples.

We supply a complete line of activated carbons for every purpose; design and prefabricate air and liquid purification, separation and recovery systems. Barnebey-Cheney, Columbus 19, Ohio.

Barnebey Cheney

valve at both high and extremely low pressures and chatterless, vibration-free performance.
Quality Control Corporation, 7315 W. Wilson Ave., Chicago 31, Ill.

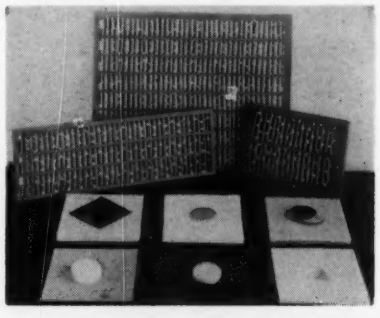
FOUR-TON HEAT PUMP

Added to the Weathertron line is a four-ton split-system heat pump utilizing all important features of other units in the series. Air handlers are available in both vertical and horizontal models, feature belt-driven, adjustable-speed blowers and operate on both 115 and 230 volt ac.
General Electric Company, Central Air Conditioning Dept, Tyler, Tex.

FILTER MATERIAL

Using a microfine rayon fiber in a matrix of Vinyon (a thermoplastic resin spun into textile fiber), this low-density nonwoven filter performs a wide range of filtration tasks. Its controlled, graded pore size is cited as affording substantially more loading capacity and longer filter life than previous materials developed. Because of its thermoplastic properties, Hovolite is heat-sealable to itself and can easily be laminated and heat-formed or shaped. It is available in thicknesses from 0.1 to 1.0 in. in rolls, sheets, die-cut pieces or fabricated parts.

Shown are materials for air movement filters (top of cut), respirator filters (round pieces), squares which



are cut to size and shape and wrapped around air filters, a rectangular piece used as a sound absorber in vacuum cleaners and (lower left) thin material used for removing water from organic substances.
American Viscose Corporation, 350 Fifth Ave., New York, N. Y.

TEMPERATURE CONTROL

By cascading of an air signal to a pressure regulator, this temperature control system offers a demonstrated control accuracy of six to eight F over a 24 hr period even under severe test conditions.•

Instantaneous load swings from 210 to 80 gpm water flow may be handled while controlling temperature to within ±5 F of the set point. Pressure-regulating action of the externally-

Acme ...the **practical** approach to air conditioning

Acme is the word for air conditioning in Atlantic City motels

Here you see just a few of the fine motels in and around Atlantic City that feature Acme air conditioning equipment. Fact is, there are more than 50 altogether . . . ranging in size from 25 units to more than 250 and in value from $250,000 to almost two million. And in every one of these motels the "heart" of the comfort conditioning systems, the chillers and cooling towers are Acme . . . the name that has been synonymous with quality and dependability in air conditioning and refrigeration equipment since 1919.

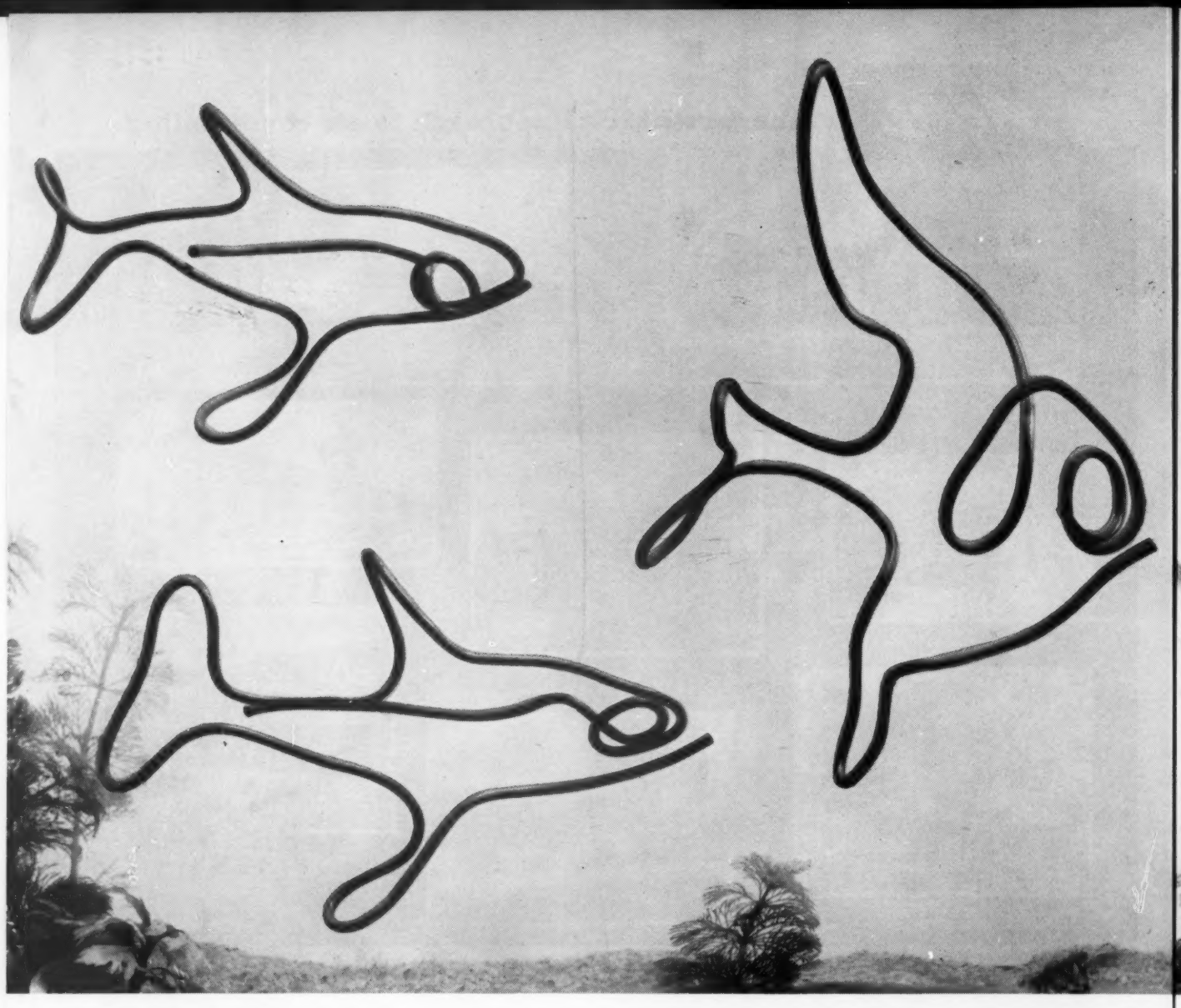
Yes, "the word" for air conditioning in Atlantic city motels is Acme. And you know why when you "add up" some of the advantages of Acme equipment . . . space-saving, cost-cutting compactness . . . easy to install, factory-assembled "packaging" . . . quiet, efficient operation . . . factory certified performance reliability. These Acme pluses, and more, are the reason why Acme systems are the answer to air conditioning for *all* types of multi-room buildings . . . motels, hotels, apartments, hospitals, offices. Call your nearby Acme sales engineer for the complete story.

Packaged Chillers, 1½-220 tons
Cooling Towers, 3-120 tons
Evaporative Condensers, 10-110 tons
Remote Room Conditioners, 200-600 cfm
Air Handlers, 665-36,000 cfm
Packaged Air Conditioners, 3-60 tons

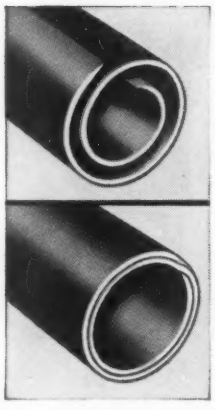
Acme INDUSTRIES, INC.

JACKSON, MICHIGAN

MANUFACTURERS OF QUALITY AIR CONDITIONING AND REFRIGERATION EQUIPMENT SINCE 1919



There's almost no limit to the things Bundy can mass-fabricate



Bundyweld is the only tubing double-walled from a single copper-plated *steel* strip, metallurgically bonded through 360° of wall contact for amazing strength, versatility.

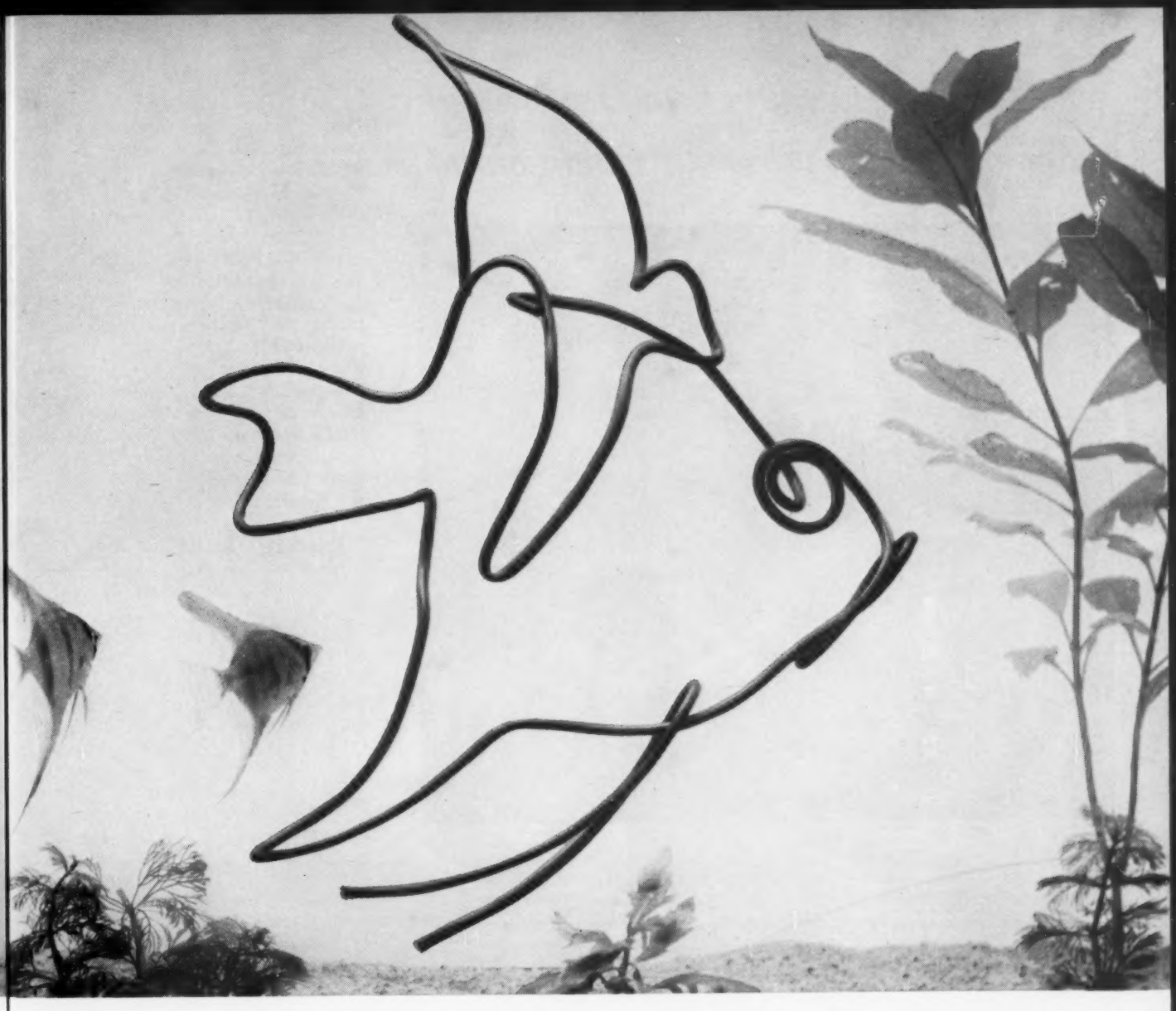
Bundyweld is lightweight, uniformly smooth, easily fabricated. It's remarkably resistant to vibration fatigue; has unusually high burst strength. Sizes up to 5/8" O.D.

When it comes to mass-fabricating steel tubing into complex shapes, the folks at Bundy® are specialists. In everything from coils and capillaries to serpentines and discharge tubes, chances are Bundy can bend it better. And here are just a few reasons why it will pay YOU to bring your tubing problems to Bundy:

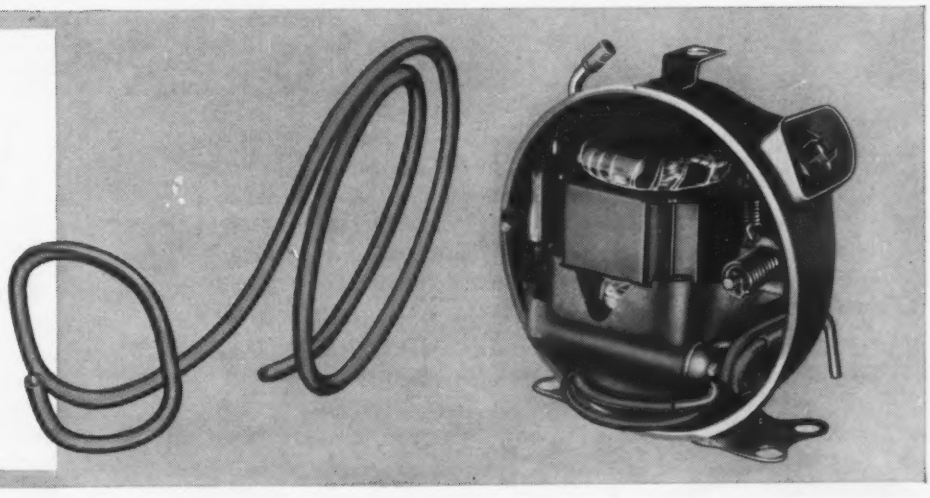
Bundyweld® Tubing is the safety standard of the refrigeration industry—double-walled from a *single* strip of steel, copper-brazed through 360° of wall contact to make it leakproof by test. And the special Bundy beveled edges result in smooth inside and outside seams . . . no inside flash to be removed.

Our designers await your call, at *any* stage of product development. Perhaps they can suggest a new "twist" that'll save you time and money in manufacture.

Bundy fabricators can mass-fabricate parts to your specifications on Bundy-designed fixtures and machines. The unit-cost is low . . . the quality high. Got a tubing problem? Better see Bundy *first!* Phone, write, or wire Bundy Tubing Company, Detroit 14, Michigan, today.



The discharge coil for this air-conditioning compressor is 5/16" x 37½" with one end sized to ⅛" I.D.; tight-tolerance fabrication allows coil to clear inner casing and outer shell of compressor.



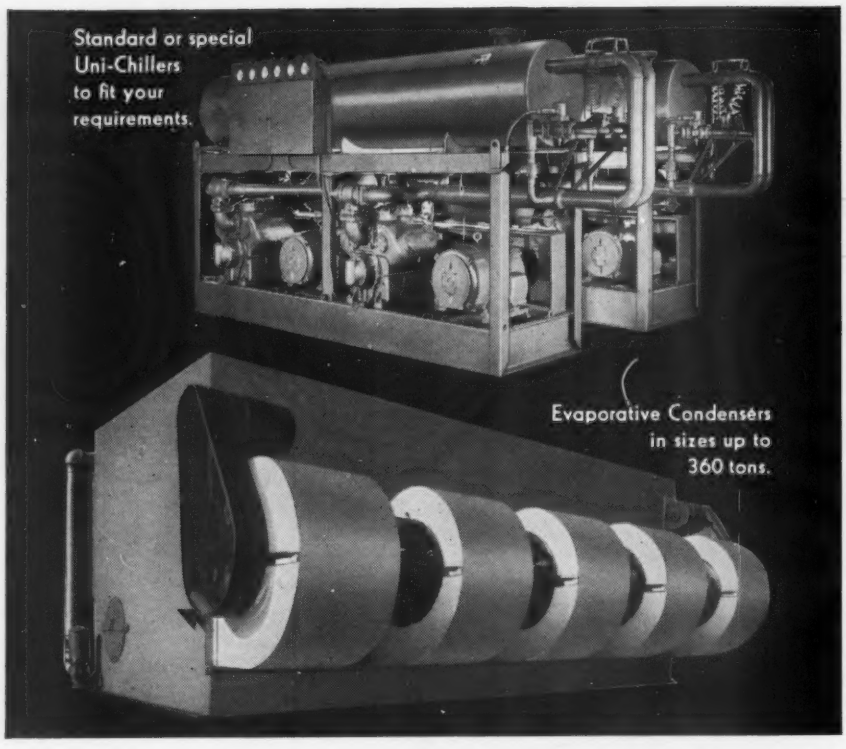
There's no substitute for the original

BUNDYWELD® TUBING

WORLD'S LARGEST PRODUCER OF SMALL-DIAMETER TUBING • AFFILIATED PLANTS IN AUSTRALIA, BRAZIL, ENGLAND, FRANCE, GERMANY, AND ITALY

BUNDY TUBING COMPANY • DETROIT 14, MICH. • WINCHESTER, KY. • HOMETOWN, PA.

Increased performance and continued lower costs with Vilter Air Conditioning



Vilter units for many air conditioning applications are designed to make every dollar count in increased performance, more economical operation, longer life, a more compact installation, and a minimum of maintenance. Years and years of research went into the design of the famous VMC Compressor and Equipment, and this research is continuing at an intensified pace—all aimed at making the VMC Compressor the most durable and efficient on the market.

Uni-Chillers—Each of the special Vilter self-contained units (shown above) consists of two compressors and 75 hp motors, condenser, water chiller and controls. The capacity of each Uni-Chiller is 150 tons. Completely factory-assembled. Compact Uni-Chillers are available in sizes from 10 tons upward.

Evaporative Condenser—The externally mounted fan of the VXF evaporative condenser (shown above) does not handle moist saturated air from the spray chamber—minimizes corrosion and extends fan life. The Evaporative Condenser saves 90 to 95% in water costs. Permits larger compressor installations where water is scarce. Low pumping cost as compared to cooling tower installation. Capacities of 30 through 360 tons.

Why not write to Vilter and see how you, too, can save money on your air conditioning and refrigeration installations.

Vilter® refrigeration air conditioning

The Vilter Manufacturing Company
Milwaukee 7, Wisconsin

Air Units • Ammonia and Freon Compressors • Booster Compressors Baudelot Coolers • Water and Brine Coolers • Blast Freezers Evaporative and Shell and Tube Condensers • Pipe Coils Valves and Fittings • Pakice and Polarflake Ice machines.

Write to Dept. AR-906 for helpful Vilter Bulletins on any of the above equipment.

piloted main valve permits rapid response to sudden changes in demand. Precise temperature control is obtained from the cascaded air system which loads the pilot.
Spence Engineering Company, Inc., Walden, N. Y.

SHOCK ABSORBER DOOR

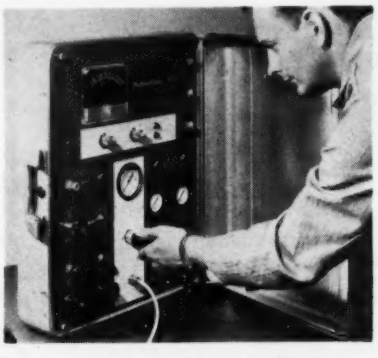
Resilient urethane-filled bumpers take the full impact of pounding by fork trucks passing through, the trucks never touching the door. Flexibly-suspended hinges provide uniform distribution of stress throughout the length of the door at either side. Drafts and noises are minimized by Neoprene seals at the periphery.
Clark Door Company, 515 Hunterdon St., Newark 8, N. J.

SOLENOID VALVES

Offered in two-way, normally-closed construction and in a wide range of voltages and frequencies with many electrical options, high-pressure models added to the Type R Series line of pilot-operated valves have an orifice size of ¼-in. diam. Operating pressure differentials are five to 1250 psi on ac voltage, five to 1000 psi on dc voltage, with higher than standard pressure ratings available for specific application. Valves are designed for use with air, oil, water and other common media.
Skinner Electric Valve Div, 105 Edgewood Ave., New Britain, Conn.

HYDROCARBON DETECTOR

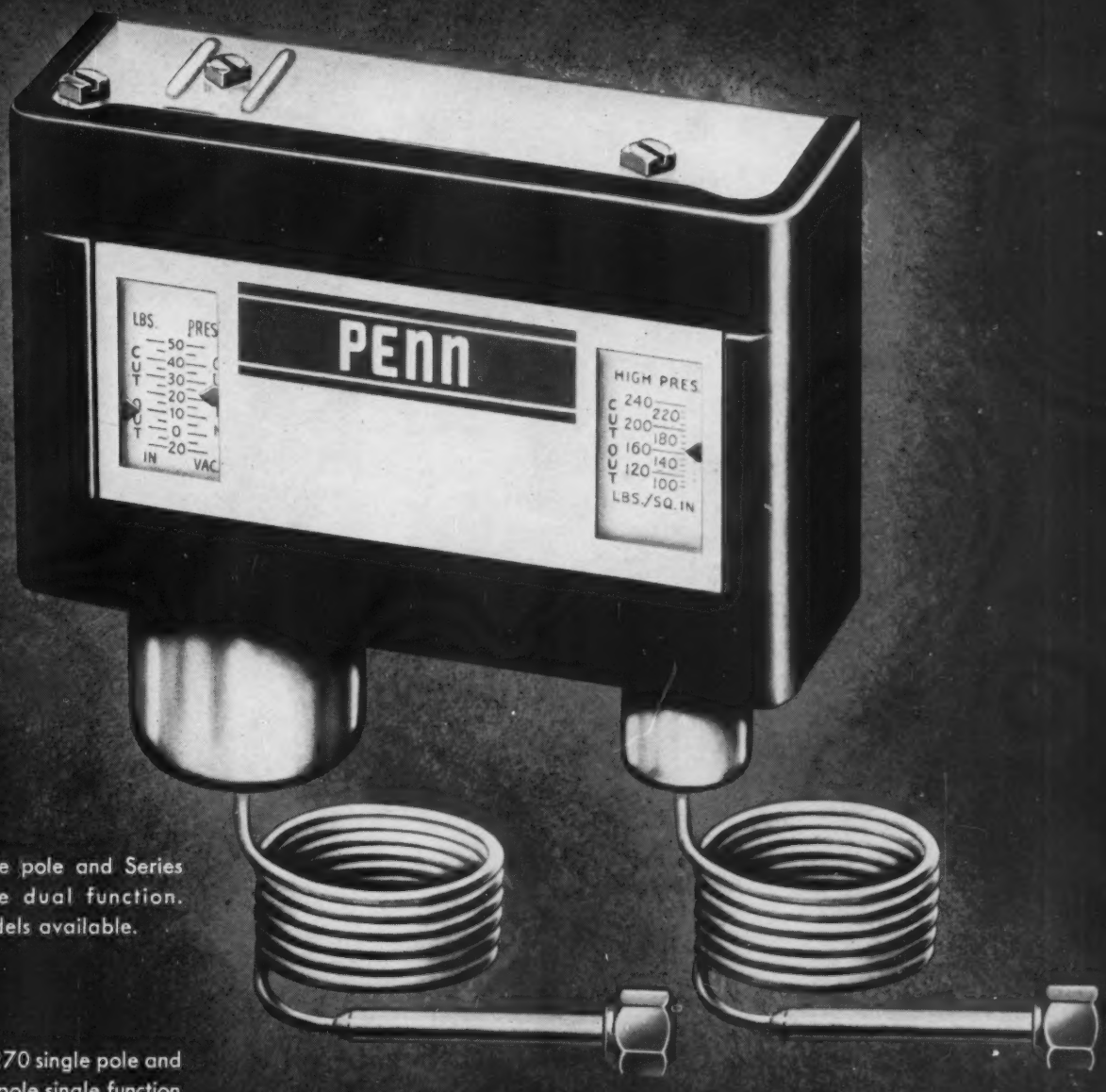
Self-contained and portable, this detector affords rapid analysis of total organically-bonded carbons in atmos-



phere or gases, and is suitable for use as an atmospheric monitor of air pollution or lower explosive limits.

Sensitivity of the instrument, designated P-E Model 213, is cited as being better than 0.1 ppm for such organic carbon compounds as hydrocarbons, aldehydes, ketones, alcohols, and amines, and free of interference from common backgrounds such as water vapor, oxygen, nitrogen and rare gases.

Heart of the device is a flame ionization detector. A metered flow is



Series 271 single pole and Series 1273 two pole dual function. Temperature models available.

Below . . . Series 270 single pole and Series 1272 two pole single function for either low or high pressure. Also temperature models.

YOU CAN DO MORE JOBS WITH LESS CONTROL INVENTORY! •

Penn's line of refrigeration controls has the capacity and versatility to satisfy all cooling requirements! Single or double pole models are available for all types of applications and are rated to handle single or polyphase motors from 1 through 5 H.P. capacity!

And, you get real economy, too. The two pole heavy duty models eliminate the need for motor starters when used on polyphase motors with built-in overload protectors. With their two separate circuits, these models are really 2 switches in 1. Don't settle for less . . . ask your wholesaler for Penn Controls!

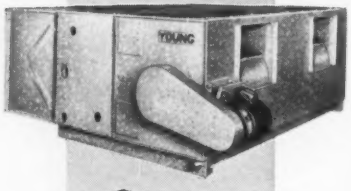
PENN CONTROLS, INC. Goshen, Indiana

EXPORT DIVISION: 27 E. 38th ST., NEW YORK, N.Y.

AUTOMATIC CONTROLS FOR HEATING, REFRIGERATION, AIR CONDITIONING, APPLIANCES, PUMPS, AIR COMPRESSORS, ENGINES

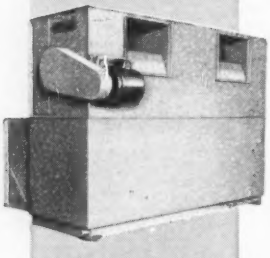
There are 3 Young Central Station Air Conditioning Units from which to Specify

Young CS Units are Easy to Install . . . Easy to Service . . . Economical to Operate



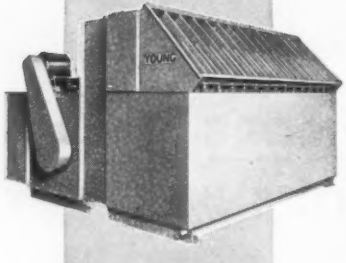
HORIZONTAL UNITS

Young CS Horizontal Air Conditioning Units offer complete flexibility with bolt-on interchangeable designed sections. Available in 10 sizes with capacities ranging from 700 cfm to 28,000 cfm assures "tailor-made" installations for practically any size building.



VERTICAL UNITS

Sectionally-designed Vertical Units are available in the same wide range of sizes and capacities. All types feature easy servicing . . . hinged panels make filters readily accessible . . . special filter removal racks are standard on all Filter Sections and Mixing Boxes for fast, easy removal or inspection of filters.



MULTIZONE UNITS

Where independent area control of air conditioning is required from a single unit, Young Multizone Units provide the solution. Nine sizes and a choice of 2 to 21 zones are available. Heating may be provided in one zone while cooling another zone simultaneously.

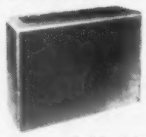
YOUNG OFFERS A COMPLETE LINE OF EQUIPMENT FOR AIR CONDITIONING ALL TYPES OF BUILDINGS

Young Engineers are Pleased to Offer their Services on Any Heat Transfer Problems

Write for FREE Catalogs on any Young Products

Remote Roomaire® Conditioners

Vertiflow® vertical discharge unit heaters



Cabinet Unit Heaters

Young

ideas for solving heat transfer problems are GOOD IDEAS

YOUNG RADIATOR COMPANY DEPT. A-570 RACINE, WISCONSIN

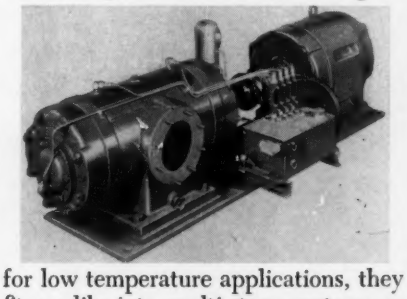
PLANTS AT RACINE, WISCONSIN AND MATTOON, ILLINOIS

fed into a hydrogen flame in an enclosed chamber; this flame ionizes combustibles in the sample to effect changes in current flow of a surrounding electrical field. These changes are proportional to total carbon content of the sample.

Perkin-Elmer Corporation, Norwalk, Conn.

ROTARY BOOSTER SERIES

Ranging in capacity from four through 400 ton of refrigeration, the rotary booster compressors added to this line are available for use with ammonia and Refrigerants 12 and 22. Designed



for low temperature applications, they fit readily into multi-stage systems as the first or booster stage.

Vilter Manufacturing Company, Milwaukee 7, Wisc.

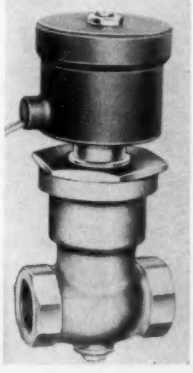
LIQUID FLUX

Developed for use with all soft solders, Duzall may be used on all metals except aluminum, magnesium and die cast. Cited as eliminating precleaning of parts, removing surface oxides and expanding the capillary action of all soft solders, it is non-acid.

All-State Welding Alloys Company, Inc., 249-55 Ferris Ave., White Plains, New York.

SOLENOID VALVE

Port sizes from ¼ to three in. characterize the 30,000 Series Valve, a full-ported, direct-lift solenoid. Designed for positive operation over this entire range, it is cited as being extremely versatile. Available in bronze or stainless steel, the valve, which is shown here, features a Uramic solenoid intended to assure reliable operation regardless of line pressure.



Atkomatic Valve Company, Inc., 545 W. Abbott, Indianapolis, Ind.

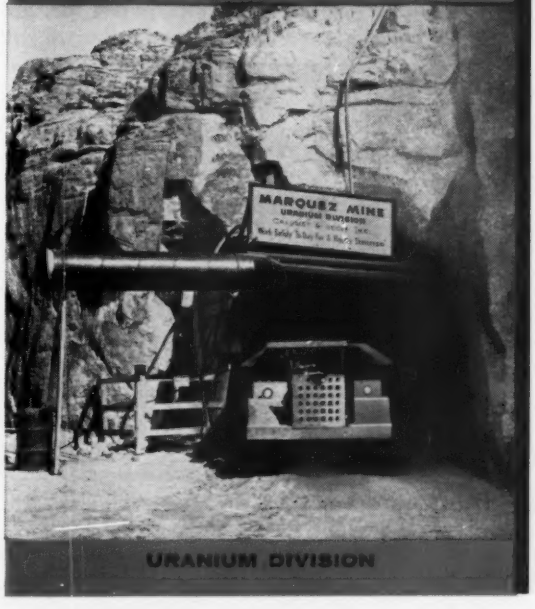
SOCKET-LOAD CENTER

Intended to meet the need for an outdoor service entrance device, this 100-amp meter socket load center provides

CALUMET DIVISION

LOOK TO WOLVERINE TUBE

GOODMAN LUMBER DIVISION



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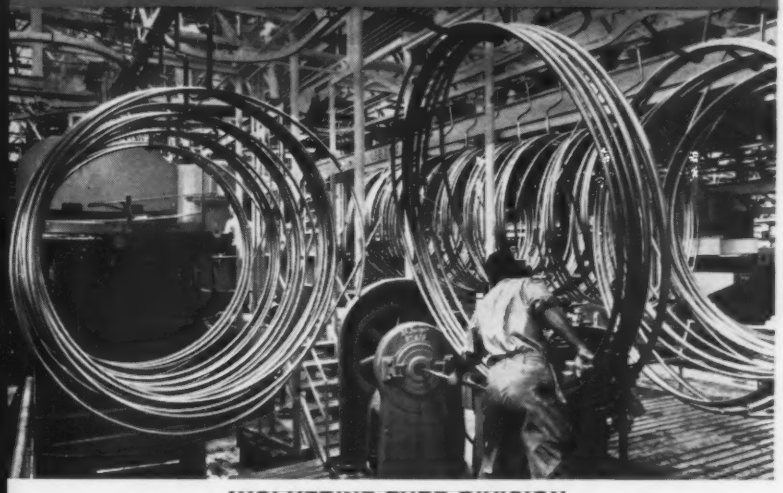

WOLVERINE TUBE DIVISION

Mining . . . refining . . . lumbering . . . agriculture . . . manufacturing — diversified indeed are the product and market areas of the companies making up the industrial family of Calumet & Hecla, Inc.

Of course, Calumet & Hecla has for many years been recognized as a copper producer. Since 1859, in Michigan's Upper Peninsula, the Calumet Division has been mining Lake copper — one of the purest forms of copper ore. The refined product is sent to Wolverine Tube Division for conversion into brass and copper tubing for plumbing installations, refrigeration, chemical and petroleum processing as well as for a wide variety of general industrial applications. Wolverine Tube is also a prime manufacturer of aluminum extrusions, and drawn and extruded aluminum tube.

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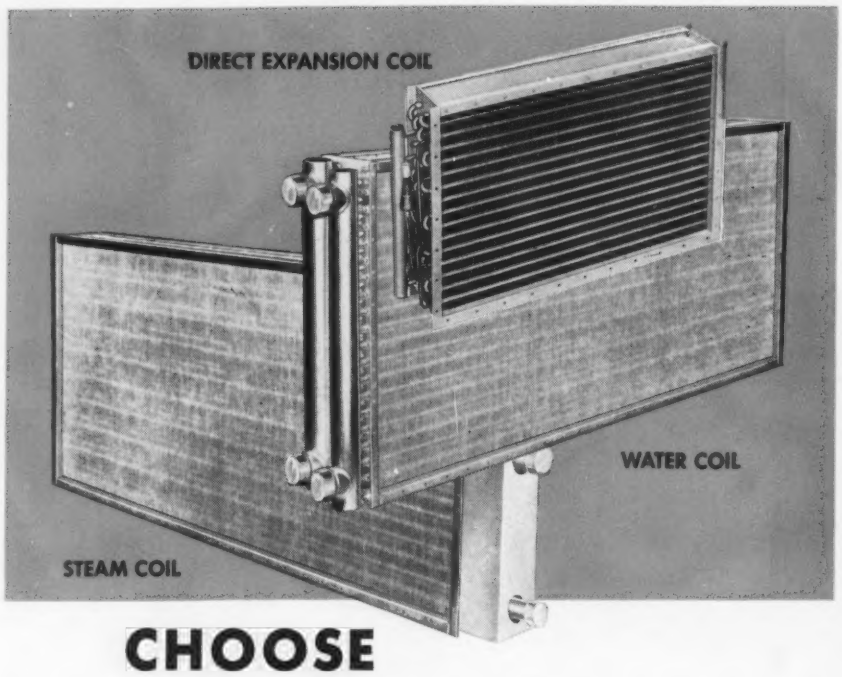

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two-pole branches for major appliance and air conditioner disconnects plus a subfeed main to a lighting and outlet circuit panel inside the home.

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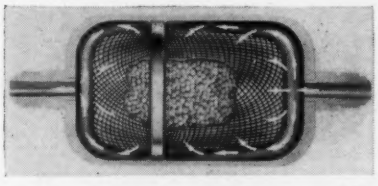

to flow. Corrosion-resistant seamless brass, spun in one piece, forms the shells. Shown is a cutaway of the filter-drier.

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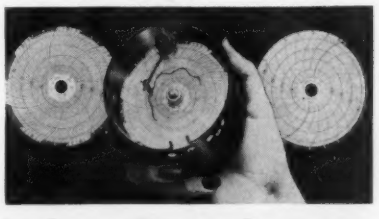

of industry. For recording temperatures of liquids or wet environments, it may be encased in a thin polyethylene bag.

Use of a dry scriber eliminates the problem of ink spilling, freezing, running or drying up. Two different time ranges and temperature ranges are available, either 20 to 220 F or −40 to 160 F and 24 hr or 7 day.

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New Century Electric motor provides low-cost power for fans, blowers, pumps and compressors.

New Century Electric part-winding motor gives extra smooth start

This new motor . . . at either 1200 or 1800 rpm's . . . will give smooth, cushion acceleration. No cogging, jerking or jarring equipment. Just dependable starting power with the same reduction in starting current of all Century Electric part-winding motors. A special winding scheme makes this extra smooth start possible.

Applications—Have an application where power company restrictions limit inrush current? The complete line of Century Electric part-winding start motors may be the answer. They provide the most economical and dependable way of starting equipment such as fans, blowers, centrifugal pumps and compressors, as well as reciprocating compressors with unloading valves.

Reliable power—High quality construction features include . . . coils insulated with tough polyvinyl acetal resin . . . windings dipped and baked with several coats of high temperature synthetic varnish which protect against oil fumes, mild acids, dust and grit . . . rotors dynamically balanced so motors run smoothly and quietly . . . rugged cast iron frame for long life and low noise level. Century part-winding start motors are available in 20 to 150 hp sizes and in speeds of 1200 and 1800 rpm.

Application aid—A Century Electric application engineer will be glad to discuss your part-winding start problems with you. Century Electric also makes a complete line of motors . . . all sizes and types from 1/20 to 400 hp. For a copy of the new Century Electric Motor Application Guide, please write for bulletin 270A. For *more* than a motor . . .

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"More and more Chicago businesses are cooling with **GAS!**"

Many Chicago firms need a compact, automatic unit that will both heat and cool at low cost. That's why – in a one year period – 275 Arkla-Servel Sun Valley Gas air conditioning units were specified and are being used in business places throughout the Chicago area.

With this central Gas unit, there's no need for fans, window air conditioners or separate cooling units. The design is so clean and simple that it can be installed wherever there is room . . . out in the open, on the roof, in the basement, or in the back room.

In addition to heating and cooling, the Arkla-Servel Sun Valley unit also cleans the air, dehumidifies and ventilates to assure year 'round comfort.

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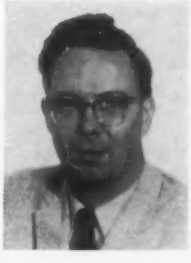
JOURNAL
OFFICIAL PUBLICATION
JANUARY 1960

How a thermal mockup aided

in air conditioning the Electra

P. S. STARRETT

P. F. HALFPENNY



Thermal mockups have proven extremely useful as an aircraft air conditioning research and development tool through the entire period from the initial evolution of system concepts to the ultimate assessment of the comfort level provided by final production hardware.

The authors here present details of the design and operation of a 40-ft thermal mockup of the Electra airplane, capable of realistic simulation of ambient conditions from —40 to 120 F.

Included are typical studies of comfort, circulation patterns, heating and cooling loads, and equipment performance during both steady state and transient conditions. A thorough investigation of the most unusual electrical radiant heating system was made possible with the mockup.

Recent years have brought marked increases in the performance and complexity of aircraft air conditioning systems. This trend, allied with increased operational capabilities of aircraft and greater demands for passenger comfort appears unlikely to reverse. To be certain that the many components of these complex systems are fully integrated to result in maximum passenger comfort, extensive testing is necessary. For these tests, thermal mockups, or thermal simulators, are used.

Most aircraft companies have constructed thermal mockups of one type or another. There was some thermal mockup testing on the Constellation, the T-33, the F104, the C130, but most recently, and by far most extensive, was the work done on the Electra.

This program included two separate air conditioning mockups and was based on the previously demonstrated knowledge that:

(1) Assessing the problem of individual passenger comfort as influenced by the air conditioning system (how the passenger will feel under the combined influence of the surfaces, windows, walls and floors which surround him, and the air distribution system which circulates air about him) is impossible without a thermal mockup.

(2) The more complete in every detail the system tested in the laboratory, the better become the chances of obtaining a final system that is entirely satisfactory, as well as reducing the flight test program, and having a production line uninterrupted by late changes and modifications.

(3) A mockup program can be used to obtain data which could not be gotten in any practical flight test program, and also to obtain general design data which will benefit future models.

MOCKUP PROGRAM

Our first mockup was limited in scope and used for only early pre-

P. S. Starrett is Research Group Engineer, P. F. Halfpenny is Research Engineer with the Lockheed Aircraft Corporation. This paper was presented as "Aircraft Air Conditioning Development Using a Thermal Mockup" at a recent ASME Aviation Conference in Los Angeles. It has not been published elsewhere.

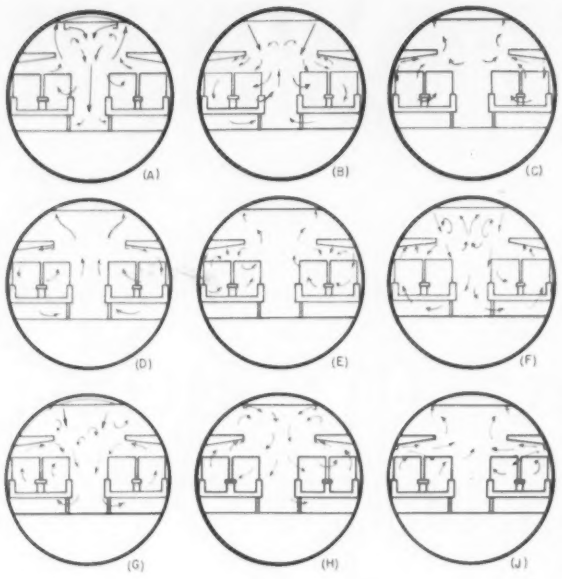


Fig. 1 Various air distribution systems evaluated in a preliminary mockup. (See Table I)

TABLE I—COMPARISON OF NINE AIR DISTRIBUTION SYSTEMS

Air flow for all tests was 26 cfm per person. In tests A, C & E 10% of the total flow was discharged downward over the windows. The systems are shown in Fig. 1. These tests were isothermal.

TEST	SUPPLY AIR	EXHAUST AIR	EVALUATION
A	Overhead. Half inch slots directed inboard along the ceiling	Overhead	Poor circulation in seating area. Poor smoke dissipation. Drafts in aisle. Some short circuiting of the flow
B	Overhead. Half inch slots directed down at 45°	Inboard edge of hatrack	High turbulence throughout the cabin
C	Outboard edge of the hatrack, using a half inch slot	Overhead	Good smoke dissipation. Poor circulation below head level. Short circuiting of flow to exhaust
D	Inboard edge of hatrack	Overhead	Floor level drafts. Large stagnant areas. Poor smoke dissipation
E	Perforated hatrack panel	Overhead	No drafts; but poor smoke dissipation and insufficient circulation
F	Overhead 1 in. slots directed downward at 45°	Perforated panels in hatrack	Drafty in aisle seats. Poor smoke dissipation. Stagnant in outboard seats
G	Overhead 1 in. slots directed downward at 45°	Inboard edge of hatrack	Same as in (F)
H	Overhead one half in. slots directed inboard along the ceiling	Inboard edge of hatrack	High velocities in aisle. Fair smoke removal, but an unstable flow pattern
J	Outboard edge of the hatrack using a two and one half inch perforated grille	Overhead	No drafts; good smoke removal. Good circulation with no stagnant areas

liminary development. It made use of an existing fuselage section 20 ft long. It was not equipped for full thermal simulation. Electrically heated floor and wall surfaces were later included and a double pass system of tubes circulating chilled water was attached to a sheet of aluminum to provide realistic window temperatures. However, no attempt was made to provide heating and cooling loads on the skin.

This mockup was used in a variety of ways; first to develop a satisfactory air distribution system; to evaluate comfort in limited non-isothermal tests; to provide data on the comfort aspects of radiant panels; and to evaluate control characteristics of the temperature control program.

Despite years of experience, the basic attack on air distribution problems still is, and probably always will be, largely empirical. No better way has evolved to assay the proper outlet and exhaust locations, the effect of jet and surface temperatures, the interaction of one jet with another, and the effect of neighboring surfaces on jet behavior, than to "try it and see." It should be pointed out that in contrast to industrial or residential practice where 2 to 10 air changes per hour are typical, the aircraft cabin ventilating rate is usually near 40 air changes per hour.

These high circulation rates make it necessary to be extremely careful to avoid drafts. This takes the form of the specific requirement to put air into the cabin with the least momentum consistent with adequate circulation. It is this requirement which makes desirable industrial practices, such as high velocity-high entrainment outlets, unattractive for aircraft applications.

A number of combinations of supply and exhaust locations, Fig. 1, were investigated, each having some advantages and disadvantages. The evaluations were based on velocity surveys, smoke tests, and jury judgements. Table I lists the results of these preliminary investigations.

The final air distribution method (J in Table I) incorporated low velocity (100 fpm) supply air outlets at the outboard edge of the hatrack; overhead exhaust in the forward and aft cabins and in the lounge; and a single low level recirculation grille in the main cabin.

A comprehensive test program was carried out to determine the outlet performance through a range of expected operating conditions. A photographic technique has been used extensively with good results. This method employs a simple optical arrangement which provides a line of light about 2 in. wide. Thus, photographs taken along an axis normal to the plane of light represent essentially a two dimensional pattern of the air paths. Zinc stearate powder was mixed with the air to provide the visual patterns, Fig. 2.

This method has been used in an attempt to isolate the pertinent parameters that affect the outlet performance. A difficulty lies in the fact that the representation of the jet pattern in some mathematical form is a ponderous problem. Compromise methods were used in which the jets are described ac-

cording to the zone through which they move, as indicated in Fig. 3.

Jets diffusing primarily onto the outboard seat zone are designated type A, those diffusing further inboard become type B, while those dropping slightly if at all become type C. A high degree of correlation was obtained using the temperature parameters of supply depression (cabin air above supply air temperature) and wall heating (wall temperature above cabin air temperature) as independent variables. The results have been charted in Fig. 4.

Included is the correlation factor representing the percentage of jets identified as to type (A, B, or C) when the temperature parameters intersected in the proper zone. The correlation is relatively high when consideration is given to the fact that specific zoning of the jet paths is not an exact thing.

The hatrack location for the supply air grille had only one serious drawback; stratification during heating conditions produced temperature differences from floor to seated head height of the order of 13 F. These gradients could be attributed to the high position of the outlet and the low outlet velocity which did not project the warm air downward. Cooling conditions were much more satisfactory. Here the natural diffusion of the cooler supply air through the passenger zone kept the floor to seated head height temperature differential within a 1 F limit.

In an attempt to eliminate stratification, a dual duct system was studied which supplied cold air at the hatrack outlets during cooling conditions, while under heating conditions warm air was brought through floor level outlets. To simulate this system, air was supplied to a narrow slot 12 in. above the floor in the wall panel. This was arranged to discharge downward. The discharge velocities could not be held much below 370 fpm with the space available for the outlet face area.

This method, together with an alternate underseat heating method utilizing a ½ in. slot outlet in the floor extending across the entire underseat area, showed no promise. In both cases the warm air drifting upward produced a stuffy uncomfortable feeling. The entrainment

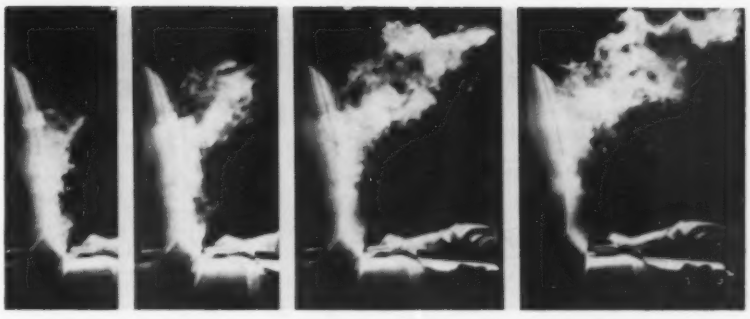


Fig. 2 Diffusion patterns obtained with a line source of light and zinc stearate trace material. Top picture at time = 0; 2nd picture at 1⅛ sec; 3rd picture at 2¼ sec; bottom picture at 3⅛ sec

of cold air in the low level jets tended to produce ankle drafts. In the case of the wall slot, the unbalanced heating on one side of the passengers' legs and ankles was objectionable, and in addition there was a tendency toward blockage of the flow inboard.

The use of low level exhaust was investigated as a means of reducing temperature stratification during heating. With all the air taken out at floor level there was some reduction in stratification, but the gradients which remained were still considered too large for comfort conditions.

The conviction remained that the hatrack outlet location was optimum for cooling, and that a method of heating without stratification could be devised. A radiant heating system was the obvious solution, and techniques for practical floor and wall panel heating were analyzed.

RADIANT PANELS

Recognizing the simplicity and weight benefits which could be achieved using electrically heated radiant panels, a panel design was begun and a series of tests initiated to determine: (a) surface temperature distribution on the panels, (b) the warm up time after power application, (c) the safety and durability aspects of the panels, and (d) the required power distribution in the floor panels to account for variations in underfloor structure and thermal load.

The panels were of standard honeycomb-aluminum construction in which a helically wound insulated resistance wire, protected with an aluminum braid, was installed during fabrication. Typical aircraft trim techniques were used to surface the panels.

It was found that the aluminum cladding on the honeycomb panels sufficiently diffused the heat

Fig. 3 Arbitrary classification of jet types according to the path of diffusion

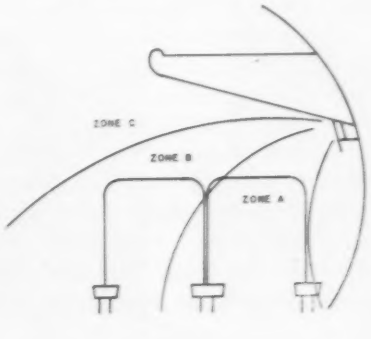
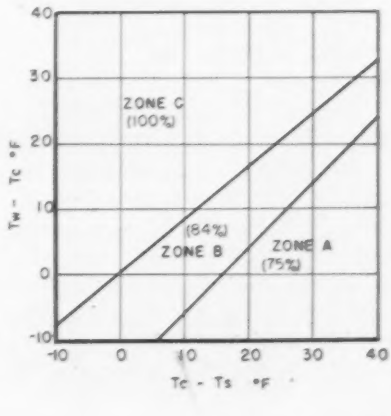


Fig. 4 Prediction of jet paths using temperature parameters. T_s = supply air; T_c = cabin; and T_w = wall temperature. Percentages in parenthesis show the fraction of jet types which were identified visually as falling in the zone predicted by the temperature parameters. Outlet velocity was 100 fpm



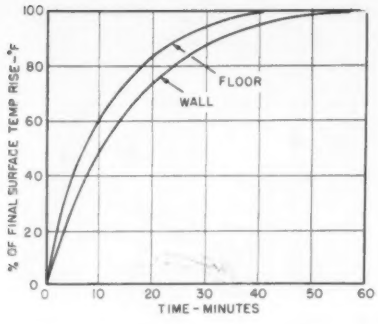


Fig. 5 Transient temperature characteristics of heated floor and wall panels

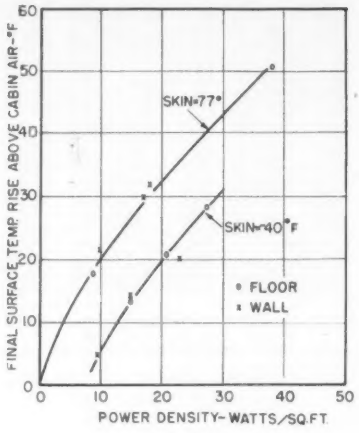


Fig. 6 Steady state temperatures of heated surfaces with variable power density and skin temperature

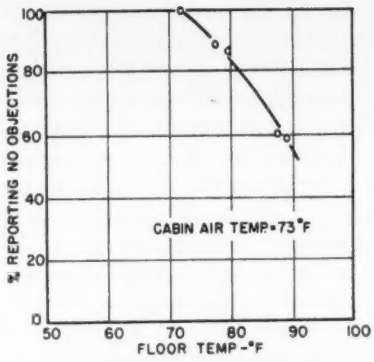


Fig. 7 Effect on comfort of floor temperatures determined by jury evaluations

from the resistance wires so that no objectionable surface gradients were observed. Although the panel response was not especially fast, as indicated in Fig. 5, it was shown to be adequate for control purposes. Supplemental air heating is used during quick warm up after a cold soak.

The steady state temperature rise achievable with the panels is shown in Fig. 6. In actual application the panel rating is 20 watt/ft², and the panels are cycled off and on by the temperature controller at that power density to achieve a programmed floor or wall surface temperature.

A total of 390.5 sq ft of the floor area is heated in the airplane, with only the aisles, vestibule, lavatories, galley and coat rack areas being unheated. The walls are heated from the floor up to the hat rack valance, a level just above the top of the windows. A total of 355 sq ft of wall area is heated.

To assure that the panels had fail-safe properties, several of the panels were pierced with sharp-edged weights during power on operation without observable arcing or fire hazard. A durability test on a typical panel is still in progress. While located in an area of heavy foot traffic, this panel has been power cycled 750,000 times, 20 sec on and 5 sec off, at 50% power overload without failure.

Subsequent operation of the panels in the thermal mockup established that, with proper use of insulating cork tape to avoid thermal short circuits through the floor supports, uniform power densities could be used in the floor panels.

The utilization of juries to evaluate the air conditioning system offers some disadvantages and pitfalls. As soon as an average passenger-subject is asked to evaluate an air conditioning system, his perceptive powers, especially his ability to detect drafts, smoke, and odors increase to a remarkable degree. Thus, we made efforts to conceal from the jury as much information as possible as to the object of the test and the way the system operated.

Of particular interest were reactions to a warm floor; therefore, the jurors were not advised of the heated floor, but were asked simply if any part of their body was too warm or too cold. The results of these tests, shown in Fig. 7, generally confirm the accepted industry maximums of 80 to 85 F for radiant floors.

Draft and smoke removal ratings were secured with juries, and, although applicable only to the specific system investigated, the data obtained on drafts agreed with that predicted on the basis of measurements and published data.

Final tests with the preliminary mockup were control explorations in which proposed controller temperature schedules were followed, noting the response and stability characteristics. Four operators were required, one to monitor the cabin temperature, and the others to control floor, wall, and supply air temperatures to the proposed schedules. It became apparent during these tests that the conceptual program was highly unstable during transient warm-ups, and temperature schedule changes were incorporated to eliminate this.

As the preliminary mockup tests were concluding, the system design had become well established; the production program was beginning. For final evaluations, to check component and system compatability and obtain data in thermally simulated flight conditions, a complete thermal mockup was built. This was full scale, representing 40 ft of structure from just aft of the flight station to the wing beam, Fig. 8. Insulation, ducting, and equipment were identical or thermally equivalent to that used in the airplane, Fig. 9. The interior was completely trimmed and furnished with a full complement of 39 seats, Fig. 10.

Facilities were required to provide heating and cooling loads throughout the design range. Of the various methods investigated, direct control of the skin temperature was chosen. The alternative, use of a large temperature chamber, was rejected as not providing the speed of response or flexibility of direct skin temperature control. With the method chosen, the skin temperature could be programmed to simulate actual flights; and it was the most direct way of obtaining the high rates of skin temperature change and the effective skin heat transfer coefficients associated with flight conditions.

To vary and control the skin temperature directly, a horizontal network of aluminum tubing, Fig. 11, (more than a mile of it) was attached to the skin with formed clips. Trichlorethylene was pumped

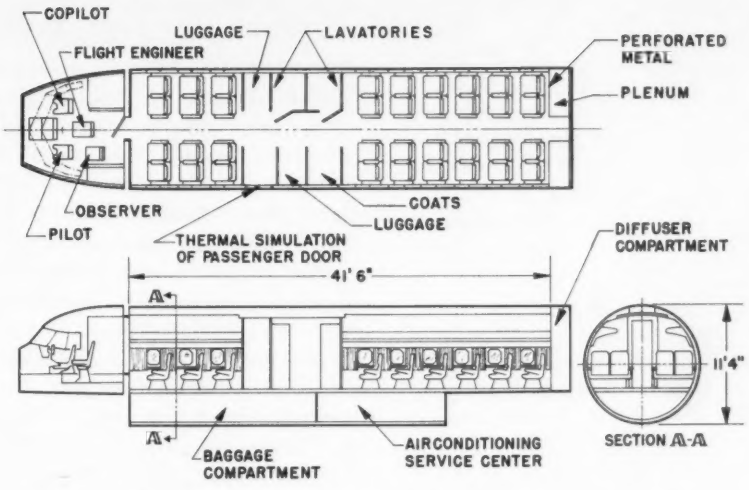


Fig. 8 General arrangement of the Electra thermal mockup

through this network at a rate of 300 gpm. Prior to circulation, the heat transfer medium was heated or cooled in large tanks.

Liquid CO_2 was expanded directly into the cold tank where temperatures of −80 F were normally obtained. The hot tank could be heated with electric immersion heaters totaling 18 kw to 175 F, just under the boiling point of the trichlorethylene. With these facilities, skin temperatures from −40 to 120 F were established with variations of only ±4 F along the full mockup.

Variable tube spacing was used, based on calculated load requirements for each section of the fuselage. This was done to minimize the tubing requirements and eliminate the need for load balancing for each temperature and internal load condition. Flows and thus loading were balanced by tube spacing and sizing only. No peripheral valving was used.

In arriving at a tube spacing in each section, the skin between any two tubes was considered to be a fin acted upon by an effective heat transfer coefficient which was a function of the internal load and external insulation. The maximum permissible tube spacing was selected as that which would allow no more than a 2 F variance along the fin surface. During construction of the mockup a fillet of conductive material was laid along each tube to improve the thermal contact between the tubes and the surface. A mixture of aluminum powder and cement having a conductivity of 0.44 Btu/hr-ft²/F/ft was used.

In general, this method of skin temperature control worked well. While the transient capabilities did not match the extremes which might be encountered in flight, reasonably fast transients could be produced for satisfactory system evaluation.

Prior to receipt of the aircraft system components the air conditioning system was simulated using commercial equipment as shown schematically in Fig. 12. The supply air was heated with air blast heaters (9 kw), or cooled with direct expansion heat exchangers having a total capacity of 9.8 ton. A portable vapor cycle system provided this refrigeration. Control stability was obtained by reheating cooled air. Proportional controllers were used to cycle the heaters and were generally satisfactory. All air flow metering was done with sharp edge orifices. Motor driven butterfly valves in the primary circuits provided manual remote flow control.

INSTRUMENTATION

Because of the quantity of data required, as much of the instrumentation as possible was designed to produce information in a form which would be handled by automatic data reduction equipment. The temperature instrumentation consisted of some 350 copper-constantan thermocouples. Thermocouple output was fed through a scanner into a digitizing voltmeter and thence into IBM card punch equipment or electric typewriters as desired. The equipment had a 200 channel capacity and was capable of one reading per second with an accuracy of ±0.01 mv.

Thermocouple locations were established to provide significant readings for the maximum number of operating conditions. Where there was no reasonable expectation of temperature variations for similar locations, the number of thermocouples was held to a minimum. For example: inside surface temperatures, where the interior

Fig. 9 Interior of the thermal mockup prior to installing heated wall panels, interior trim and seats

Fig. 10—Completed interior of the thermal mockup

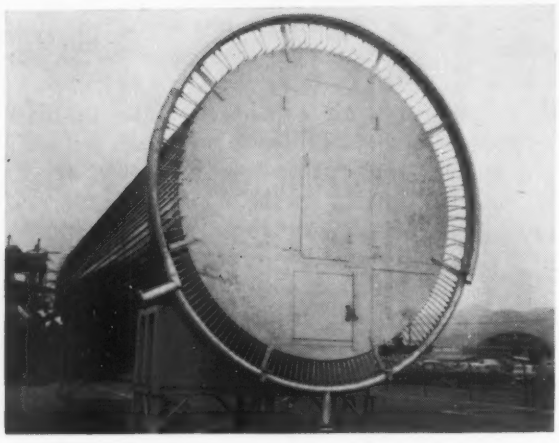


Fig. 11 Arrangement of tubes used to control mockup skin temperature

was symmetrical, were taken only on one side. Floor temperatures were taken in a stratified random pattern for the purpose of general investigations.

The system was provided with sufficient roving thermocouples to provide complete local coverage and flexibility. Static and total pressure instrumentation was read out on a 36-tube inclined manometer with a range of 0 to 6 in. of water readable to 0.05 in. of water. The manometer board was internally illuminated and data were recorded photographically.

The first phase of the overall mockup program was devoted to an evaluation of the production version of the ducts and distribution system. Typical of an aircraft system, the ducting contained both design and manufacturing tolerances. Balanced flow to all zones was obtained only by adding restrictors and deflectors at critical points. The requirements were that the various cabin sections receive equal air flow and that the individual outlets be uniformly supplied. To eliminate much of the trial and error work normally associated with this type of development, the restriction requirements were based on test values of the total system resistances.

Resistance was defined as pressure drop divided by weight flow squared. The resistance of each section of duct was determined from the pressure drop and flow data. The resistances could then be treated similarly to electrical resistances though the formulae are slightly modified by the squared term. That is: to add R_1 and R_2, resistances in series; $R = R_1 + R_2$. And, to evaluate R_1 and R_2, resistances in parallel:

$$R = \frac{R_1 \times R_2}{R_1 + 2\sqrt{R_1 R_2} + R_2}$$

By tabulating these values, the required additional resistance could be calculated and added to the circuit in the form of restrictors in the duct. The final flow distribution obtained was uniform within ±3% of the design distribution.

HEATING AND COOLING

Although the mockup structure consisted of half of the airplane, it could not be assumed to represent half of the total loss. To determine loss factors for heating and cooling that could be extrapolated to represent the entire airplane, a series of tests was made in which the interior was compartmentized to separate the various types of internal configuration. Insulated partitions were used to isolate the forward cabin, vestibule, and main cabin.

These sections then were treated individually to determine the effects of the heated forward baggage compartment, the unheated air conditioning service center, and the mass of the main wing beam. In addition the mockup was sectioned peripherally using horizontal partitions consisting of six inches of Fiberglas insulation on the floor and across the top of the hat racks. By isolating the sections this way and guarding against end effects, each segment of the cabin was investigated, heating and cooling loads obtained and a more accurate extrapolation to the full airplane made.

DEVELOPMENT OF SYSTEMS AND COMPONENTS

Following the thermal evaluation of the aircraft and as parts and equipment became available, a complete aircraft air conditioning system was installed in the mockup. Fans, filters, heaters, and air cycle and refrigerant systems were included. The engine-driven compressors were omitted; functionally replaced by heated plant air. A detailed performance evaluation of the individual systems was not attempted since this type of testing can be best accomplished with individual test facilities where there can be complete control of the parameters and better instrumentation and access to the units.

It was necessary to do a large amount of developmental work on the refrigerant system when various forms of interaction were discovered in the mockup. These tests resulted in major changes. A variable superheat, constant evaporator pressure system was finally used. Temperature stratification out of the evaporator was eliminated with a single vane turbulator in the supply riser. The turbulator consisted of a slanted baffle attached to the outboard face of the duct. It had a length equal to twice the duct width and projected into the duct 4/10 of the duct depth.

TEMPERATURE CONTROL

To determine system compatability, all associated systems were operated in a series of flight simulating programs. The controller maintained a selected cabin temperature by modulating the air cycle output temperature, refrigeration capacity and radiant surface temperatures. In addition, it had the capability of independent control of radiant surface temperatures in each of 4 zones to allow for varying heat loads due to changes in occupancy.

The control input consisted of signals from a cabin master sensor, from radiant surface and air sensors in each zone, and from a duct rate sensor. It was necessary to determine that the sensors were sampling representative temperatures. Except for the radiant sensors and the duct sensor, changes were made in all sensor locations. The master sensor was moved from within the

recirculation ducting to a point near the duct grille to eliminate errors due to duct loss, and was shielded from the outboard duct wall to eliminate radiation errors. The zone control sensors were moved from the inboard edge of the hatrack to locations below the air outlets and air at 100 fpm was drawn across them to improve their response.

Approximately 150 hours of mockup operation were required to match the response of the various pieces of heating and cooling equipment to the thermal response characteristics of the fuselage; then to eliminate developmental problems discovered.

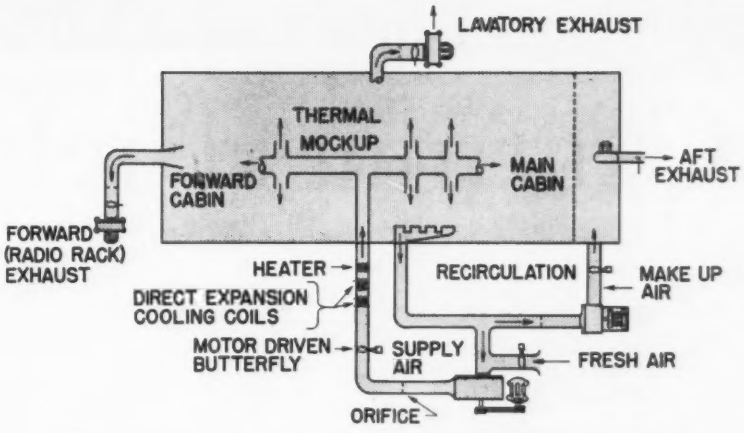


Fig. 12 Air supply and exhaust systems used to simulate aircraft equipment

Some of the more general conclusions from the Electra thermal mockup program are:

Air Distribution: The relatively high ventilation rates per unit volume used in aircraft systems necessitate great care in the design of the cabin air outlets. A low velocity, under hatrack outlet avoids drafts in the seated zones while scavenging smoke and preserving a minimum air movement for freshness. Such an outlet should not be used for heating. Air circulation and temperature stratification patterns are generally much more sensitive to outlet position than to exhaust location. Low level heating with warm air is not workable in the confining volume of an airplane.

Radiant Heating: Application of electrically heated radiant panels to aircraft results in high comfort levels, minimizing temperature gradients and yielding dividends in light weight and control flexibility. Jury tests indicate that floor temperatures above 80 F are undesirable. Wall temperatures, however, can be operated at 90 F without discomfort.

System Development: The thermal mockup was particularly valuable in development of the integrated air conditioning system, especially the refrigeration system and the temperature controller. Because of mockup space limitations, as in aircraft, the development of components is not wholly convenient.

Heating and Cooling Loads: Present analytical methods used in calculating heating and cooling loads are sufficiently exact for present design and performance requirements. Future models will require extensive mockup testing to verify system capacities and comfort levels.

UNDERGROUND CONDITIONING SYSTEM AIDS AIRPLANE PRODUCTION

Located under a plant wing sealing area in Boeing Airplane Company's Wichita Div is an air conditioning and heating system designed as the solution to a problem arising in manufacture of wings for B-52G bombers. Use of wings as fuel tanks in this type of airplane requires inner sealing of the wing sections prior to attaching them to the fuselage. Sealing crews climb inside the sections, apply a plastics sealant, check for leaks and then rapidly cure the sealant. Fumes and heat generated by these operations produce nearly unendurable conditions inside the wing, making necessary installation of a system capable not only of air conditioning but also of providing water and heat for the curing process.

An underground system of tunnels, piping and ducting with individual hookups and controls for each wing was installed. Intake fans draw in outdoor air through one tunnel, leading it to combination units for heating or cooling, while exhaust fans draw contaminated air from wing sections into the other tunnel to be exhausted outside the plant. In addition to heating, cooling and exhaust lines laid into the area, water lines for each wing section were installed for cleaning purposes along necessary sewage lines which hook into an industrial waste water collection system. Trane Company equipment was used.

CHILLED WATER LINES INSULATED

Problems arising from condensation were eliminated before they began when chilled water lines leading from a refrigeration unit to the general offices of Firestone Tire & Rubber Company in Akron were run through a rubber processing area where high humidity conditions exist. These lines, 1⅛ and 1⅜ in., are run over a skid storage area, where condensation on them could have made a major traffic aisle slippery and fallen on stored material and on a portion of a conveyor.

To prevent vapor from forming on the outside of these pipes, a foamed plastics insulation material, Armstrong Armaflex, was used. The closed cellular structure of this insulator provides high thermal efficiency and prevents warm, humid air from coming into contact with the cold lines.

Some things favoring turbine-driven

Centrifugal refrigeration

equipment and systems

Many factors enter into the analysis and determination of the type of refrigeration system to be used when steam is available from either existing or contemplated boiler capacity as a power source.

In general, where steam pressures above 35-40 psig are available the turbine will prove to be the best application. These turbines are generally operated condensing at 26-27 in. Hg vacuum. At 125 psig inlet condition, steam rates of 12 lb/hp hr on large horsepowers and 16-17 lb/hp hr on small horsepowers are regularly available. Steam surface condensers for this steam consumption are available in sizes to match the turbine selection. Auxiliary horsepower for all sizes of turbine-driven centrifugals consists of 1/6 hp oil pumps and ½ hp purge unit. The oil pump will have a service factor of 1 whereas the purge compressor will operate about 20% of the time. Steam absorption machines, for example, require from 5 hp on the smallest size to 14½ hp on the largest size which operate continuously. The nominal steam rate for absorption machines using 12 psig steam is 19.4 lb/ton hr based on 45 F chilled water.

Turbine-driven centrifugals and the steam condenser require 3 gpm/ton of 85 F cooling tower water returning to the tower at approximately 105 F; whereas the absorption machines will require an average of 3.5 to 4 gpm/ton of 85 F water returning to the tower at approximately 101 F. The turbine-driven machine will generally require a smaller tower with less fan horsepower due to the lower quantity of water at a higher temperature head on the tower. Resultant windage and evaporation losses are also lower. Pumping costs for condenser water are lower as a result of the reduced quantity of water handled.

Since refrigeration systems do not operate at full load 100% of the time, the part load performance becomes an important consideration in operation cost. Seasonal operation on air conditioning applications will vary from 2000 hr/season in the warmer climates to 1200 hr/season in the Northern areas of the U. S. It is rather difficult to pinpoint exact hours of operation at any given load point but in general it can be assumed that full load operation will occur only 20% of the time, 75% load – 30%, 50% load – 40%, and 25% load – 10%.

Turbine-driven centrifugals at part load performance generally are highly efficient in that the horsepower required at part load falls off at a faster rate than does the tonnage, resulting in a low total steam consumption at part loads. In practice a further contribution to low steam consumption results from the fact that on those days that reduced loads are encountered the cooling tower water is below design temperature, which causes the steam condenser to operate at increased vacuum thus increasing the efficiency of the turbine.

W. G. DORSEY, JR.

Absorption machines, on the other hand, have a steam rate based upon ton-hr rather than hp-hr which results in the tonnage falling off at a rate greater than the total steam consumption. For example, at 75% tonnage the steam consumption would be 80% of full load consumption. See Fig. I. Absorption machines cannot take advantage of reduced condenser water temperatures as by their nature they require a relatively constant temperature in the absorber and condenser and a throttling bypass valve is always furnished with the machine to maintain this constant temperature. It should be noted here that absorption machines cannot operate at steam pressures higher than about 12 psig, consequently where steam

TABLE I CAPACITIES (TON)

	200		430		600		700	
	C	A	C	A	C	A	C	A
Steam Consumption full load (lb/hr)	3460	4230	6720	8880	8578	12450	9035	14300
Auxiliary hp	5/6 Int	10 Co	5/6 Int	14½ Co	5/6 Int	14½ Co	5/6 Int	14½ Co
Cooling Tower Fan (hp)	15	20	30	37½	45	60	45	60
Makeup Water (gpm)	66	90	115	175	180	245	210	260
Pumping Horsepower Condenser H_2O	20	40	40	100	80	120	60	75

C—Centrifugal. A—Absorption. Co—Continuous. Int—Intermittent.

W. G. Dorsey, Jr., is Zone Manager, Air Conditioning and Refrigeration Div, Worthington Corporation. This is a condensed version of "Turbine-Driven Centrifugal Refrigeration Systems" as presented at the ASHRAE annual meeting, Lake Placid, N. Y., June 22-24, 1959. The full paper will appear in ASHRAE Transactions.

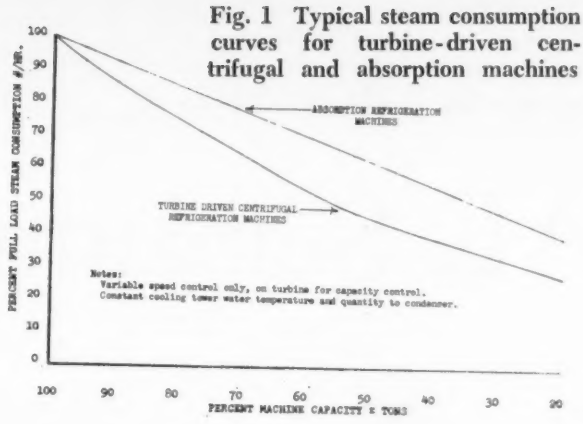


Fig. 1 Typical steam consumption curves for turbine-driven centrifugal and absorption machines

pressures are higher in the distribution system a pressure reducing station must be used which in itself is a loss of power in the heat balance. While there is some advantage to the absorption machine due to the fact that condensate is returned to the boiler at approximately 200 F while the steam condenser returns condensate at 120 F, this credit is offset, however, by the lower total steam consumption operating from distribution steam pressure on the turbine. The absorption machine must be charged with the cost to attain the distribution steam pressure and the loss of potential power through the pressure reducing valve. Turbine-driven centrifugals less steam condenser require space as follows:

> Smallest machines – 8 ft wide x 14 ft 10 in. long x 6 ft 9 in. high
> 700 Ton – 12½ ft wide x 19 ft 2 in. long x 9 ft 9 in. high

Steam condensers will require 2-3 ft width and about 12 ft length over the entire range. An allowance of about 10 ft at one end must be available for tube removal.

Absorption machines for comparable tonnage to centrifugals:

> Smallest machines – 5 ft wide x 19 ft long x 8 ft high
> Largest machines – 6 ft 8 in. wide x 25 ft 6 in. long x 11 ft 3 in. high

An allowance of 16-20 ft at one end must be available for tube removal.

When considering the total space required including tube removal allowance the total sq ft of floor space will be about the same with the absorption machine requiring a long narrow space and the turbine-driven machine space requirements being shorter in length and somewhat wider.

Turbine-driven centrifugals with their steam condensers are about 25% higher in operating weight than the absorption machines; however, this does not affect the overall cost except in the most critical of existing buildings for upper floor installation.

The question as to the type of operating personnel required often arises as well as whether any operation is required. Often, local codes require operators for refrigeration machines but exclude absorption machines by a technicality where water and/or lithium bromide is not included in the list of refrigerants. It is an accepted fact, however, that for an investment of the sizes discussed here some provision is always made for operators – whether by building or plant maintenance people or by specific machine room personnel.

Noise level comparisons between centrifugals and absorption machines are misleading. Windage noises exist in turbines and compressors as well as gas noise in condenser and cooler. In the absorption machine steam condensate flashing and evaporation noises in the evaporator exist, so the comparison is really one of type and frequency of noise rather than the existence or nonexistence of noise. In nearly all cases either machine is installed in a machine room with other mechanical equipment such as fans and pumps, elevator motors, etc., so that the noise from the refrigeration machines becomes unimportant in the overall picture.

The turbine-driven centrifugal is essentially a manual start automatic operation machine. The control system consists of a thermostat in the chilled waterline operating pneumatically the turbine governor to adjust speed of the turbine to maintain a constant leaving chilled water temperature. If the capacity continues to fall to a point where speed regulation of the turbine is beyond the scope of the governor or stability of the compressor (generally about 15% of full load tonnage) the speed of the turbine is maintained constant and the control automatically positions inlet guide vanes on the compressor to regulate capacity.

If it is desired to maintain the unit on the line at extremely low capacities, the standard manual hot gas bypass may be made automatic and will function below the capacity range of the turbine speed and inlet guide vane regulator. This will allow a minimum capacity for stable operation of about 5% of full load capacity. Generally, for air conditioning applications the speed regulation of the turbine and inlet guide vane control are sufficient.

First cost of turbine-driven centrifugals including steam condenser, cooling tower and condenser water pumps (installed) are generally lower than for absorption units.

Cost comparisons can be made utilizing local steam costs, electricity and water rates. Average figures which may be used for estimating are \$0.80/1000 lb steam, \$0.015/kwhr and \$0.60/CF/1000 cu ft water. While these specific cases show the savings which may be attained, each individual job should be analyzed on its own merits as many variables such as steam and electric rates, water rates for specific turbines, steam pressures, chilled water temperature desired, etc., are involved and will be reflected in operating costs. An important analysis is part load performance and this should be made on the basis of an entire season's operation. A little ingenuity on the part of the designer will result in improvement of the heat balance by use of turbine-driven auxiliaries as well as turbine-driven chilled and condenser water pumps.

Dallas, Fort Worth Chapters will be hosts to

ASHRAE Semiannual

Second of the National Meetings of merger-formed ASHRAE (Lake Placid in June of 1959 was the first), the forthcoming Dallas Semiannual Meeting will provide certain established program features and the introduction of newer ones.

As part of the merger plan, President A. J. Hess who became head of ASHRAE in June, will yield that office to D. D. Wile. Similarly, at the next Annual Meeting (Vancouver, June 13-15) the latter will be succeeded by Walter A. Grant. Incoming President Wile will take office at the Welcome Luncheon on Monday, February 1.

In conjunction with the Dallas meeting, the 2nd Southwest Heating and Air Conditioning Exposition (see page 62, this issue) will be held in the Memorial Auditorium. To permit full opportunities for the gaining of the benefits inherent in the Exhibition for members and guests, Technical Sessions, Symposiums and Forums will be held in the mornings only.

There will be four Technical Sessions, four Symposiums and six Forums. A total of 17 formally prepared papers will be presented, some by title only, at the Technical Sessions.

Symposiums will review the use of plastics in domestic refrigerators and problems allied with commercial refrigeration, fenestration, window air conditioners and automotive air conditioning.

Social events include the Welcome Luncheon on Monday at which Dr. Willis M. Tate, President of Southern Methodist University, will be the guest speaker, a Texas Round Up that evening and the Banquet and Dance on Wednesday. Dr. Kenneth McFarland, Educational Consultant, General Motors Corporation, will address the Banquet on aspects of education and industry.

Advance room reservations have been heavy. The Exhibition has been a complete sell-out for some weeks. It is estimated that a registration of 2500-4000 may be totaled.

Here is an outline of the program.

Filling the 110,000 sq ft of exhibit space at the Dallas Memorial Auditorium, the 2nd Southwest Heating and Air Conditioning Exposition is being held in conjunction with ASHRAE's Semiannual Meeting

First Technical Session

An Analysis of the Necessity to Insulate Floors of Cold Storage Rooms at 35 F—J. D. Hovanesian, Assistant Professor, Dept of Agricultural Engineering, Pennsylvania State University, H. F. Pfost, Professor of Flour and Feed Milling Industries, Kansas State University, and C. W. Hall, Professor, Dept of Agricultural Engineering, Michigan State University.

A Method of Comparing Heat Exchangers—D. G. Rich, Sr. Research Engr., Carrier Corp.

Frost Formation on Refrigeration Coils—W. F. Stoecker, Associate Professor, Dept of Mech. Engrg., Univ. of Illinois.

Frost Formation Upon a Thin Aluminum Tank Containing Liquid Oxygen—J. L. Loper, Sr. Research Engr., Western Co.

Second Technical Session

Noise Reduction Characteristics of Package Attenuators for Air-Conditioning Systems—Norman Doelling, Bolt, Beranek and Newman, Inc.

Attenuation and Generation of Sound in Elbows with Turning Vanes—Wm. F. Kerka, Research Engr., ASHRAE Research Lab.

Draft Performance of Chimneys—W. G. Brown and C. Wachmann, Research Officers, Div. of Bldg. Research, National Research Council of Canada.

Saturated Steam Flow in Copper Tubing—C. M. Humphreys, Asst. Dir., J. T. Baker, Research Engr., and B. H. Jennings, Director, ASHRAE Research Lab.

Re-evaluation of Steam-Pipe Size Tables for the ASHRAE GUIDE—Wm. F. Kerka, Research Engr., ASHRAE Research Lab. By title only.

Third Technical Session

Effect of Compressor Characteristics on Motor Performance—E. H. Jensen, Air-Conditioning Div., Westinghouse Elec. Corp.

Muffler Analysis by Digital Computer—B. W. Hatten, Westinghouse Elec. Corp. and D. F. Miller, Westinghouse Research Labs.

Use of Activated Charcoal to Decrease Odor and Odor Transfer in Domestic Refrigerators—A. L. Brody, Food Technologist, J. W. Thomas, Chem. Engr. and L. M. Lafeber, Home Economist, Whirlpool Corp. Research Labs.

Solar Heat Gain Factors for Windows with Drapes—Necati Ozisik, Res. Engr. and L. F. Schutrum, Res. Supervisor, ASHRAE Research Lab.

1 Meeting February 1-4

Fourth Technical Session

Alaska Summer Weather Data—A. Burggraaf, Design-Draftsman, Harmon and Beckett, Inc.

A Rational Method of Determining Summer Weather Design Data—H. C. S. Thom, Chief Climatologist, U. S. Weather Bureau.

Sensation Responses to Temperature and Humidity under Still Air Conditions in the Comfort Range—Dr. Walter Koch, Medical Res. Supervisor, B. H. Jennings, Director and C. M. Humphreys, Asst. Director, ASHRAE Research Lab.

Proposed Humidity Standard—C. E. Till, formerly Jr. Research Officer, Div. of Bldg. Research, National Research Council and G. O. Handegord, Prairie Regional Station, Div. of Bldg. Research, National Research Council, Univ. of Saskatchewan.

Domestic Refrigerator Engineering Symposium: Should Plastics Be Used in Refrigerators?

Chairman—H. P. Harle, Proj. Eng., Adv. Engrg. Appliance and TV Dept., General Elec. Co.

Keynoter—W. L. Farley, Vice President, White Stores Inc.

Realistic Properties of Plastics Materials Applied to the Requirements of the Refrigeration Industry—Wm. E. Brown, Head of Testing Section, Plastics Tech. Service, Dow Chemical Co.

Assurance of Satisfactory Performance of Plastics Parts in Refrigeration—Dale Amos, President, Amos Molded Plastics Div., Amos-Thompson Corp.

Air-Conditioning Symposium: Engineering Responsibilities

Chairman—Wm. R. Moll, Sales Mgr., Air-Cond. and Dehumidifier Sales to Sears, Whirlpool Corp.

P. M. Augenstein, President, Airtemp Div., Chrysler Corp.

Austin "Russ" Rising, Vice Pres. and Dir. of Marketing, York Div., Borg-Warner Corp.

William Spiegelhalter, Chief Engr., Room Air Conditioner Section, General Elec Co.

Gerhardt Stoll, Dir. of Research, Whirlpool Corp.

Psychrometric Chart Symposium

Chairman—P. N. Vinther, Consulting Engr., Zumwalt and Vinther.

High Altitude Psychrometric Charts—R. W. Haines, Consulting Engr., Bridgers and Paxton.

Psychrometric Chart for Altitudes Above Sea Level—J. L. Threlkeld, Professor, Dept of Mech. Engrg., Univ. of Minnesota.

The Psychrometric Chart Can Be Improved—C. M. Ashley, Chief Staff Engr., Carrier Corp.

Psychrometric Charts from the Users' Viewpoint—D. D. Wile, Vice Pres. and Chief Engr., Recold Corp.

Thermodynamic Consistency in the Graphical Presentation of Psychrometric Data—J. A. Goff, Professor, School of Mech. Engrg., Univ. of Pennsylvania.

Fenestration Symposium: The Role of Fenestration in Air-Conditioning

Chairman—Professor E. R. Queer, Engrg. Research, Pennsylvania State University.

W. W. Caudill, Architect. P. N. Vinther, Consulting Engr., Zumwalt and Vinther. W. F. Spiegel, Consulting Engr., Charles S. Leopold, Inc.

Forums

E. N. Johnson, Engineer, Swift and Co. in charge.

Thermoelectric Effect—Moderator, E. R. Wolfert, Mgr., Refrigeration and Environmental Research, Whirlpool Corp. Research Labs.

What Are the Practical Limitations on the Application of Air-Cooled Condensers?—Moderator, D. E. Kramer, Engineer, Kramer-Trenton Co.

Design for Freeze Protection and Effective Operation for Supply Air Systems—Moderator, John H. Clarke, Engineering Supervisor, Visking Co., Div. of Union Carbide.

Method of Air Conditioning Automobiles—Moderator, King A. Koch, Koch Engineering & Sales Co.

Frozen Food Storage—Moderator, E. J. Robertson, Research Engineer, Wilson & Company.

Pipe and Pick-up Factors for Heating Boilers—Moderator, L. E. Seeley, President, H. B. Smith Co.

ASHRAE headquarters will be the Baker Hotel

ABSTRACTS OF TECHNICAL AND CONFERENCE PAPERS

FIRST TECHNICAL SESSION—MONDAY, FEBRUARY 1, 9:30 A.M.

Analysis of the necessity to insulate floors of cold storage rooms at 35 F

J. D. HOVANESIAN
Assistant Professor
Agricultural Engineering
Pennsylvania State University

H. F. PFOST
Professor,
Flour & Feed Milling Ind.
Kansas State University

C. W. HALL
Professor
Agricultural Engineering
Michigan State University

The general practice of placing 2 in. of cork equivalent insulation in the floor of "slab-on-soil" construction was evaluated. A storage temperature of 35 F was assumed and three cases were considered: (1) 20 x 20 ft storage without floor insulation, (2) 20 x 20 ft building with footing perimeter insulation and (3) 10 x 10 ft building (inside a building at 70 F) without floor insulation.

This study was based on the hypothesis that if floor heat gain/sq ft can be shown to be less than wall heat gain/sq ft no floor insulation is needed. To calculate wall heat transfer is straightforward, but floor heat transfer determination is another problem.

A numerical solution to Laplace's equation was used for finding soil temperature distribution. This technique is called the "Method of Relaxation" and one needs to know boundary conditions for its application. Once the soil temperature distribution was determined, a numerical integration technique was used for calculating actual floor heat flow. The numerical integration was performed between a selected isothermal surface and the floor. Because the thermal resistance between the floor and isothermal surface varies throughout the floor area, the floor was divided into several area increments. The thermal resistance and finally the heat flow through each area increment was determined, totaled and averaged/sq ft. This was compared to the wall heat flow.

On the basis of results obtained, the use of floor insulation was not justified for the cases studied. Heat flow/sq ft through the wall was found generally to be much higher than through the floor. When storages are smaller sized than about 10 x 10 ft, however, this conclusion may be questioned. Surprisingly, addition of footing insulation did not appreciably reduce losses. Therefore, the authors seriously question the practice of using floor or footing insulation for the storages such as those described.

A method of comparing heat exchangers

D. G. RICH
Senior Research Engineer
Carrier Corporation

Determination of an optimum heat exchanger geometry is complicated by the fact that both the heat transfer rate and the friction loss may vary over wide ranges for commonly used surface configurations and that the requirements for optimum surface area, weight, volume, and costs may not be identical. In order to compare and evaluate heat exchangers having different heat transfer and friction performance characteristics, it is desirable to assume that each operates at the same flow rate, mean temperature

difference, total heat transfer rate, and pressure drop, in which case the velocity, face area, and depth are variables.

Under these comparison conditions the parameter $\Delta_p\ \theta_m/\theta_a$, called the coil rating factor, is fixed. It can be shown that this factor is virtually independent of the over-all size of the heat exchanger and, consequently, may be computed from the core cell dimensions and the heat transfer and flow friction data. By plotting the heat transfer coefficient versus the coil rating factor for various heat exchanger geometries, it is possible to compare their surface area requirements under identical operating conditions. Likewise, by plotting the heat transfer coefficient divided by the core volume, weight, or cost per unit surface area, it is possible to compare the core volume, weight, or cost requirements under identical operating conditions. The face velocity may also be plotted versus the coil rating factor enabling a comparison of relative face area requirements under identical performance conditions. All of these comparisons – surface area, volume, weight, cost, and face area – have a common parameter, the coil rating factor, so that all may be made on a single chart having a single abscissa and multiple ordinates. Although many other factors must be considered, such a chart provides a valuable basis for the comparison and eventual optimization of heat exchanger geometries.

Frost formation on refrigeration coils

W. F. STOECKER
Associate Professor
Department of Engineering
University of Illinois
Member ASHRAE

The initial deposit of frost on a horizontal pipe coil roughens the surface and increases the coefficient of heat transfer. As frost continues to accumulate, the coefficient remains somewhat constant until the air passages begin to become blocked whereupon the coefficient drops. This maintenance of a nearly constant coefficient of heat transfer is attributable to two causes: one is the increase in external surface area, and the other is the increase in conductivity of the frost as the frost becomes more dense due to aging. These two effects compensate for the increased resistance to heat transfer brought about by the thickening of the frost deposit.

In this study the author shows how the presence of neighboring pipes in the coil and radiation from the pipes increase the coefficient of heat transfer over that of a single tube and cause an accelerated rate of deposit of frost on the side of the tubes.

Frost formation upon a thin aluminum tank containing liquid oxygen

Results of a transient heat flow analysis are presented for the problem of an accumulating thickness of frost on a cold cylindrical aluminum tank exposed to the atmospheric elements.

Equations are presented which can be employed to predict the following characteristics of frost formation: the heat transfer rate, frost thickness, and air-frost interface temperature as functions of time. The heat transfer mechanisms of water-vapor diffusion, convection, conduction, and radiation were considered. Certain atmospheric effects influencing the formation of frost were included in the analysis. They were the dry bulb temperature, relative humidity, wind velocity and thermal radiation. The effect of direct solar radiation was not considered.

J. L. LOPER
Senior Research Engineer
The Western Co.

Reliable data for frost density and frost thermal

conductivity are necessary in making a satisfactory prediction of the frost accumulation and the accompanying heat transfer rate. Calculation results indicate that frost affords effective thermal insulation after the lapse of approximately one hour. It initially increases the heat transfer rate because of the influence of mass diffusion. But as frost forms, it provides increasing resistance to the flow of heat. Frost formations at high humidity conditions afford better insulation after a certain time period than formations at lower humidities because of the more rapid build-up of frost in the more humid air.

Wind plays an important role during the initial time periods, but as frost accumulates, the wall becomes less sensitive to convection effects as self-insulation builds up.

SECOND TECHNICAL SESSION—TUESDAY, FEBRUARY 2, 9:30 A.M.

Noise reduction characteristics of packaged attenuators for air-conditioning systems

NORMAN DOELLING
Senior Consultant
Bolt, Beranek and Newman Inc.

Noise reduction vs. frequency characteristics of about twenty commercially-available packaged attenuators have been measured. A single measurement technique, commonly called the end difference method, has been used to determine these characteristics.

The important parameters which effect noise reduction are discussed and illustrations are drawn from the measured data in order to aid the reader in estimating the noise reduction characteristics of other attenuators. At present, all manufacturers use approximately the same materials and construction techniques. As a result, length and percentage of open area are the only important variables which influence noise reduction values.

Some simple rules of thumb for selecting appropriate mufflers are derived by comparing a measured noise reduction spectrum with a typical spectrum for noise reduction requirements.

Attenuation and generation of sound in elbows with turning vanes

In the past, the determination of sound levels within ducts has taken little note of the noise generated by the system components due to air flow. As the air velocities in ducts are steadily increasing, the problem of noise generation may be serious enough to offset any attenuation normally expected in the elbows, filters, coils, and even sound traps of the system.

The purpose of this study, therefore, was to determine both the noise generation and attenuation in elbows with turning vanes, and to apply this information in predicting the acoustic performance of duct systems. Because an elbow (as normally mounted) is acoustically and physically coupled to adjacent straight duct, studies of the sound attenuation in unlined and uninsulated ducting of different sizes and aspect ratio were also conducted.

A correlation of the sound attenuation and generation in elbows versus size, aspect ratio, and angle was also made. The noise-generation studies were made at air velocities ranging from 2000 to 5000 fpm. Although all ducting and elbows were fabricated from aluminum alloy and all were of standard Navy design, the results and method of analysis can be applied to commercial duct components.

W. F. KERKA
Research Engineer
ASHRAE Laboratory
Member ASHRAE

Draft performance of chimneys

Draft, efficiency and friction loss data obtained with a specially instrumented masonry chimney were compared with previous data and with calculations based on model tests. By measuring the draft differentially

between the chimney inlet and points along the vertical flue it was possible not only to simulate chimneys of different heights but also to separate the influence of wind over the chimney top. By eliminating these irregular wind effects the friction loss in the chimney could be determined with sufficient accuracy to show a strong natural convection influence. This natural convection caused friction loss values much higher than in isothermal flow. The isothermal friction losses were determined from tests on a model of the chimney which was operated in the same range of Reynolds numbers encountered in the full-size chimney.

W. G. BROWN

Research Officer
National Research Council of Canada
Division of Building Research

By the differential method of draft measurement three chimney heights (6.0, 16.3 and 22.7 ft) were studied. At low gas flow rates the shortest chimney showed the greatest efficiency, while at high flow rates the 16.3 and 22.7 ft chimneys offered the best performance.

A comparison of the draft effect of wind over the chimney top with that determined in model tests showed general agreement, and indicated that wind effects can be treated separately from steady state operation without wind. Other correlated test data are presented.

C. WACHMANN

Formerly Research Officer
National Research Council of Canada
Division of Building Research

Saturated steam flow in copper tubing

C. M. HUMPHREYS

Assistant Director, Research
ASHRAE Research Laboratory

Member ASHRAE

J. T. BAKER

Research Engineer
ASHRAE Research Laboratory

Member ASHRAE

B. H. JENNINGS

Director of Research
ASHRAE Research Laboratory

Member ASHRAE

An analytical study was made of the flow of low pressure steam in copper tubing, 2½ in., and smaller, and the results are presented in the form of flow charts for 3.5 psig and 12 psig steam. Calculations were made by the d'Arcy equation using friction factors based on Reynolds numbers.

Pressure drops were also determined experimentally at various steam flow rates in tube sizes from ⅜ in. to 1½ in. Good agreement between calculated and measured pressure losses is shown when comparison is made on the basis of average flow rates variously encountered.

Tests were also made to determine the critical steam velocity above which condensation in the main would be picked-up and carried with the steam through branches taken from the main with tees looking up at 45 degrees. These critical velocities, which ranged from ⅜ to 1½-in., are shown to increase with tube size, and to occur at an approximately constant pressure drop.

Re-evaluation of steam pipe size tables

In conjunction with the activities of the Research Advisory Committee on Hot Water and Steam Heating, the ASHRAE Laboratory began a survey late in 1956 directed toward determining the origin and validity of all of the information on steam and condensate flow that appeared in the ASHRAE GUIDE at that time. Simultaneous with this, a survey of

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Research Engineer
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Member ASHRAE

ARTHUR J. HESS
President

D. D. WILE
First Vice President
and President-Elect

W. A. GRANT
Second Vice President

ASHRAE SEMIANNUAL MEETING WILL BE HELD IN DALLAS

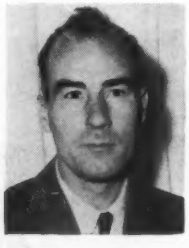
manufacturers of steamheating equipment was made in order to evaluate their comments on the steam-flow capacity tables.

The steam-flow data, in all GUIDES prior to 1959, were based on the commonly used Unwin-Babcock equation with its generally accepted friction factor. This equation had been suspected for years of being unrealistically conservative in the smaller pipe sizes. The results of the industry survey also bore out this observation of conservatism that had resulted from the use of the Unwin-Babcock relationship in designing installations.

To bring the GUIDE material up to date, and more in line with the present theory of fluid flow, a program was initiated to revise all of steam-flow data in accordance with the Reynolds Number, friction-factor concept. The results of this effort were presented in Chapter 26 of the 1959 GUIDE.

THIRD TECHNICAL SESSION—WEDNESDAY, FEBRUARY 3, 9:30 A.M.

Effect of compressor characteristics on motor performance



E. H. JENSEN
Air Conditioning Division
Westinghouse Electric Corp.

Hermetic motors for compressors have generally been treated in the same manner as motors used on steady loads. The effect of a pulsating load is to decrease the power factor of a given motor, when compared to a steady load. Analysis of the instantaneous values of the motor current for a motor-compressor combination shows that there is a definite relationship between the compressor design and the current variation produced by the pulsating load.

A theory for the pulsating load effect is proposed to explain why different types of load give different power factors for the same motor. Among ordinary designs available to the engineer there is a variation in compressor amps from one design to another of as much as 25% for the same cooling capacity.

It is also pointed that a motor which is oversized will draw a higher current than should be expected on the basis of power factor alone.

R. H. TULL
Third Vice President

J. EVERETTS, JR.
Fourth Vice President

F. Y. CARTER
First Treasurer

J. H. FOX
Second Treasurer

S. J. WILLIAMS
Program Chairman
Chairman, First Session

W. E. FONTAINE
Chairman, Second Session

R. A. LINE
Chairman, Third Session

R. S. BUCHANAN
Chairman, Fourth Session

Muffler analysis by digital computer

D. F. MILLER
Research Engineer
Westinghouse Research Laboratories

B. W. HATTEN
Senior Engineer
Westinghouse Electric Corp.

A method of analyzing the acoustic response of muffler systems used in refrigeration apparatus is presented in this paper. The analysis is based on the distributed element equations representing the vibration of gas within a tube. Expansion chamber type muffler systems are represented as interconnections of tubes of different lengths and areas. The effects of intake and discharge systems upon the muffler response are also included.

Computations are handled by means of a high-speed digital computer. It is possible to determine the frequency response curves of the muffler system at any desirable points in the muffler system. Interpretation of these computed response curves with respect to the acoustic excitation present, makes it possible to judge muffler effectiveness in attenuating the pulsating components of pressure or flow.

Since the equations correctly represent the standing wave effects in the combined tube system representing the muffler system, the computed results are accurate up to higher frequencies than often considered. Accuracy is maintained up to frequencies where transverse wave effects become important. Computed results are compared with experimental tests of a muffler system showing quite favorable agreement.

A comparison is made with the results of a lumped element analysis. This shows that unless wave effects are considered, conclusions regarding the attenuation of the muffler in the higher frequency ranges may be quite erroneous. Several practical applications of the method are discussed.

The digital method provides answers to muffler design problems with speed, accuracy and a great saving in time and effort as compared with other analysis methods.

Use of activated charcoal to decrease odor and odor transfer in domestic refrigerators

Use of granular activated coconut shell charcoal as a means of decreasing odor and odor transfer in domestic refrigerators was investigated by objective and subjective means. Odor adsorbent was placed in direct path of air stream of forced air circulation refrigerators, out of air path, and in refrigerators without forced air circulation. Both gas-tight refrigerators and conventional domestic refrigerators under simulated household conditions were studied. Odor measurements were made by use of an activated charcoal train odorometer in conjunction with trained human panelists, and by a chemical volatile reducing substances method.

Granular activated coconut shell charcoal, used under both extreme and simulated household conditions, reduced refrigerator odor and odor transfer between foods. Most efficient odor decreases were found when activated charcoal was placed in the path of forced air used for cooling; adsorber out of path of forced air was less efficient, as was adsorber in cabinet without forced air; but all three were significantly superior to controls with no adsorbent present.

A. L. BRODY
Food Technologist
Whirlpool Corporation

J. W. THOMAS
Chemical Engineer
Whirlpool Corporation

L. M. LAFEBER
Home Economist
Whirlpool Corporation

Solar heat gain factors for windows with drapes

N. OZISIK
Research Engineer
ASHRAE
Research Laboratory

L. F. SCHUTRUM
Research Supervisor
ASHRAE
Research Laboratory

Effectiveness of drapes in reducing solar heat gain through sunlit glass windows was investigated by testing with the solar calorimeter drapes of different material and color in combination with different type glasses. An equation is presented by means of which the total heat transferred through a glass and drape combination can be calculated. In this equation the solar heat transfer factors K_D and K_d are introduced to determine the solar component of the total heat gain. K_D and K_d factors can be obtained from the curves given in the paper, knowing the solar absorptance and transmittance of the drape material and the type of glass used in combination. When, however, only the solar reflectance of the material is known, K_D values can be determined to within an error of not more than 10 percent from another set of curves.

Overall coefficients of heat transfer for drape and glass combination are given. In order to provide representative information concerning drapery materials, description of the materials and their solar properties are included.

FOURTH TECHNICAL SESSION—THURSDAY, FEBRUARY 4, 9:30 A.M.

Alaska summer weather data

Outside summer psychrometric design conditions for the three principal Alaskan cities (Anchorage, Fairbanks, Juneau) are examined in accordance with suggestions of the TAC on weather data. This information is tabulated over the period of record from 1950 to 1955. In order to calculate summer solar gains in the latitude of the Alaskan cities, solar gain values for 60 and 65 degs north latitude were established and are included.

The summer design dry-bulb temperature is the maximum 6-hourly outdoor temperature which has been equaled or exceeded 2½% of the total period

of record in the months of June, July and August. The summer wet-bulb temperature is the maximum 6-hourly wet-bulb temperature which has been equaled or exceeded 5% of the total period of record in the months of June, July and August.

The ground temperatures for Anchorage and Juneau are recommended by U. S. Government Agencies. The ground temperature for Fairbanks is an average monthly temperature taken at a depth of 15 ft for a two-year period (October 1946 to September 1948). The wind velocity is the average of the summer wind velocities, recorded hourly, for the period of record (June 1953 to August 1955).

The daily range of temperatures for Anchorage, Fairbanks and Juneau is taken as the difference between the average of the average monthly maxima and the average of the average monthly minima for the month of July. The period of record is from the time the station came into existence to July 1955.

The summer solar data were arrived at through the following process:

1. Establishing latitudes for the cities involved.
2. Establishing values of K, the cosine of the incident angle for various wall orientations at the above altitudes.

R. BURGGRAAF

Harmon & Beckett, Inc.

3. Finding the values of γ, the wall solar azimuth, and β, the solar altitudes.
4. Using Chapter 13 of the 1958 Guide and the following equation: Total heat flow through glass section = transmitted solar radiation + absorbed solar radiation + convective and radiative exchange between outer surfaces of glass and outdoor surroundings.

The first part of the right hand side gives the values for instantaneous rates of heat gain due to transmitted direct and diffuse radiation. The second part of the right hand side gives the values for heat absorbed in glass. The third part gives values for low temperature radiation and convection which is not a function of latitude.

A rational method of determining summer weather design data

H. C. S. THOM

Chief Climatologist
U. S. Weather Bureau

The weather design variable problem involving comfort conditioning factors is discussed generally herein. This is specialized to the two variable design problem as it applies to cooling load design which involves wet and dry bulb temperatures. Although no valid basis had been established for doing so, engineers had always chosen the wet and dry bulb design values and their associated probabilities independently.

A statistical demonstration shows that this procedure gives the same probability for the combined effect of wet and dry bulb temperatures as the probabilities ordinarily chosen separately for these two variables and is therefore valid. It is shown that the old TAC type average frequency design variable cannot give a rational estimate of the design probability and does not limit the risk of repeated failure of a system during spells of hot weather in the individual cooling season.

A weather design variable is developed which effectively limits the risk between cooling seasons as well as within cooling seasons. The wet and dry bulb temperatures are expressed in the form of design variables and the climatological analysis necessary to obtain design probabilities is given. The methods are illustrated by application to Philadelphia and St. Louis.

Choosing the same probabilities as employed in the 1959 GUIDE for winter outside design temperatures, design values for eight major cities are obtained which are shown to agree on the average with the design values in common use. This shows that winter and summer risks quite properly are nearly the same. The new design values have the advantage that they define exactly the weather design risks facing the engineer and are derived by rational methods which can be applied in a uniform manner to meteorological station records.

Sensation responses to temperature and humidity

This paper presents the results of the second research program carried out at the ASHRAE Laboratory to determine the thermal responses of subjects under various environmental conditions after extended occupancy of approximately three hours. The subjects wore normal summer clothing, and were at rest. Air

motion in the test room was minimal, and room surfaces were maintained at approximately the dry-bulb temperature. Tests were conducted at dry-bulb temperatures from 68 to 94 F, with relative humidities from 20 to 90%.

The paper shows that the line of optimum comfort is a straight line on a dry- and wet-bulb temperature plane and the effect of relative humidity change is small. Respective points on the optimum comfort line at 77.6 F dry bulb and 30% relative humidity and 76.5 F at 85% r.h. show that the effect of relative humidity through this 55% range is only 1.1 F.

It should be recognized that increased activity, and impressions felt immediately on entering the room would, of course, show deviations from this. Decrease in weight of winter clothing with the passage of time since the 1920 decade may account for the fact that in winter at 50% r.h. a 4 F higher dry-bulb temperature is now desired for optimum comfort whereas there is little change in the summer comfort temperature at this humidity.

WALTER KOCH
Medical Research
Supervisor
ASHRAE
Research Laboratory

Proposed humidity standard

C. E. TILL
Formerly Jr. Research Officer
Member ASHRAE

G. O. HANDEGORD
Associate Research Officer
Member ASHRAE

Division of Building Research
National Research Council of Canada

The accurate calibration of humidity sensing devices requires that a suitable standard be available, either in the form of an instrument or a reference atmosphere. This standard, to be consistent with the formulations given in the Final Report of the International Joint Committee on Psychrometric Data, must either measure a fundamental thermodynamic property or produce an atmosphere in accordance with the definition of that thermodynamic property or process.

All of the humidity measuring instruments available, or described in the literature, either fail to meet these requirements or suffer from serious practical limitations in accuracy or utility. The same may be said for devices designed to produce reference standard atmospheres, except for those in which a saturated moist air condition may be established.

The condition of saturation, as defined in the report of the Joint Committee, is most readily obtained in a practical atmosphere produced by recirculation of the moist air over a water or ice surface in a closed system. Such a device, employing a two temperature principle, has been constructed and its performance studied at the Prairie Regional Station, a division of the National Research Council of Canada. The atmosphere producer has been established as capable of an accuracy of 0.2% r.h. through the full range of relative humidities from 10 to 70 F. It is proposed as a reference standard for the calibration of humidity sensing devices which do not add or remove moisture from the air.

DOMESTIC REFRIGERATOR ENGINEERING SYMPOSIUM—MONDAY, FEBRUARY 1, 9:30 A.M.

Should plastics be used in refrigerators?

HAROLD P. HARLE

Presiding Chairman

Plastics materials have been used for many years by the domestic refrigerator and freezer industry, and by the domestic air conditioner industry. A great variety of parts, functional, decorative, and structural, has been made of plastics. Some of these appliances have been notably successful, while, unfortunately, others have been a source of trouble and complaint.

As a result, quite often the use of plastics for a specific application has been questioned. In many cases parts have failed as a result of poor design or choice of material on the part of the engineer. Customers have expressed the feeling that to them plastics parts implied cheapness or lack of quality. Sometimes plastics usage has been questioned by groups who felt that a certain set of standards they had, correctly or incorrectly, established were not ade-

quately met. In other cases the aging characteristics of the material have not been compatible with the expected useful life of the part.

In an attempt to provide a better product to household refrigerator manufacturers in the form of materials and finished parts, the Society of the Plastics Industry, Inc., has been working with the ASHRAE 4.2 Technical Committee to determine the requirements of our industry, and to work out satisfactory standards and test procedures which will permit plastics material suppliers and custom molders to more adequately meet our needs.

Because of these efforts, the Domestic Refrigerator Engineering Symposium Committee felt that this was an excellent subject for the Dallas meeting. Following a keynote speaker, two papers will be presented by representatives of the SPI. These papers will present the collective views of a great many of the material suppliers and custom molders in the plastics industry. Following the formal presentations, we will deviate somewhat from our normal procedure by enlarging the speakers panel to include additional representatives of the SPI who are experts in their specific areas of the plastics field. This should allow the audience to get the most authoritative answers to their questions during the discussion period.

Realistic properties of plastics materials applied to the requirements of the refrigeration industry

W. E. BROWN

Head of Testing Sect.
Plastics Technical Service
Dow Chemical Co.

The realistic properties of an engineering material are those which affect its behavior when it is subjected to the ambient environment of the application in which it is used. Plastics material suppliers and refrigerator manufacturers have long recognized the need to know more about the realistic properties of plastics used in domestic refrigerators, and this paper presents some selected properties which have been studied extensively during the past two or three years, in the interest of improving the performance and customer acceptance of plastics in domestic refrigerator appliances.

A full range of thermosetting and thermoplastic materials has been considered in selecting the properties for discussion in this paper, and data have been taken from approximately ten different materials manufacturers in a cooperative project to bring the most complete and most needed information on behavior of plastics to refrigeration engineers.

Some of the properties which will be discussed are as follows: strength vs. temperature, long time strength and stability under load, heat distortion vs. load, chemical resistance, and odor. Line drawings, photographs, and actual samples will be used to illustrate the paper.

Assurance of satisfactory performance of plastics parts in refrigeration

Fabrication factors, or processing technology, are equal in importance to the realistic properties of plastics in producing refrigerator components which provide satisfactory performance. The functional requirements of the components are related to processing technology in such fashion as to require careful blending by the design engineer to maintain functional integrity with economical quality production.

Engineering and quality control needs are complex in the refrigerator manufacturing operations. Design engineers need means of testing materials and components to determine if the design is satisfactory for the intended use and if the material is satisfactory for the proposed design under consideration. Manufacturing sections need quality control tests for their own products, and to check components supplied by vendors, as well as to check the quality of incoming plastics raw materials.

Relation of functional factors to the various means of forming plastics components, injection molding, extrusion, and vacuum forming will be discussed in the most important phases of current needs for systematic knowledge. Several practical test methods for raw materials and components will be described. Illustrations and sample parts will provide effective visual aids during presentation of this paper.

DALE AMOS

President
Amos Molded Plastics Div.
Amos-Thompson Corp.

AIR CONDITIONING SYMPOSIUM—TUESDAY, FEBRUARY 2, 9:30 A.M.

The Air Conditioning Symposium this year will deviate from our past practice of discussing specific design details or criteria. We shall cover the much broader area of "Engineering Responsibilities".

We have in the past debated general design, compressors, coiling, paint, corrosion, fan motors and almost every component with sincere intent for these are most certainly the engineer's basic concern.

In addition, the executive engineer has another duty; he must transpose, correlate or communicate

W. R. MOLL
Presiding Chairman

his work to the Management Group, to the Sales Department and the Service Department and all other functions of his company. He must be versatile enough to relate ordinary engineering data into a working tool for other groups. It seems "understandable communication" might sum it up.

We all have experienced room air conditioners whose control panels were so complicated and the ordinary operating instructions were so technical the normal housewife wouldn't touch them merely because she didn't understand them. Even after we went to great expense to install comfort features for her, she did not understand how to operate the equipment she had.

This, of course, is an obvious example, but it points to our failing and at the same time, amplifies the potential the engineer holds to contribute to the success or failure of his product at the retail level.

These are "Engineering Responsibilities".

Engineering for engineering's sake?

PAUL M. AUGENSTEIN
President, Airtempt Div,
Chrysler Corp.

Our industry is still basically a craft born of incentive and still basically technical. Technical ability, I would be the first to admit, is beneficial in the accounting, the sales, and, yes, even in the executive branches of our industry; but I would also call to your attention that there is a quite as important requirement for the engineer to improve his knowledge of the accounting, the sales, and the executive problems of the industry.

Far too often, the engineer, in taking care of his segment of responsibility, becomes inbred to the extent that he sees engineering for engineering's sake alone and not as it should be – the backbone of an integrated, cooperative whole, bringing a needed and desirable benefit to humanity. In the final analysis, he must design the product balanced to suit the customer, knowing all of the technical possibilities and at the same time the limitations, and using this information positively and never as a roadblock.

Creative engineering—key to market leadership

AUSTIN RISING
Vice President
Director of Marketing
York Div.
Borg-Warner Corp.

Requirements of the market place are constantly changing due to a great variety of factors. These factors include:

1 Economic condition of the country.

2 Acceptance of air conditioning on the part of the buying public varies with geographic location and climatic factors.

3 Desires of customers for particular features, such as small size, quietness, etc.

4 Quality of sales job done to interest prospective purchaser in buying a room air conditioner instead of some other consumer product.

5 And many other factors.

The company which will make most progress in increasing sales and profits is one in which the engineering function is brought closely to the demands of the market and is well integrated with the sales effort. In the room air conditioner industry, our design engineers can do much to further the sales of room air conditioners. Good engineering, from a value standpoint, will be taken for granted and the premium will go to the companies whose engineering and marketing groups can have at the market place products and features which the customer wants for the price he is willing to pay.

Engineering responsibility and the challenge

W. G. SPIEGELHALTER
Chief Engineer
Room Air Conditioning Sect.
General Electric Co.

Engineering responsibilities go beyond the general impression that engineers take basic ideas and concepts and reduce them to either graphic or physical products. Engineering responsibility is getting more complex and I wonder, as engineers, if we have accepted this new challenge.

First, where does engineering fit into an organization, and what status does engineering have? It is my opinion that engineers should have equal status in management with Marketing or Sales, Finance, and Manufacturing. Engineers also have a responsibility to communicate clearly and with authority their position in business.

The room air conditioner is a most competitive consumer item with a high degree of technical content. Thus, the engineers' role in the design of such a product may be quite difficult unless he makes himself heard and understood when the specifications of the product are written.

His responsibility to the design primarily includes reliability, serviceability, quality, and innovation. In addition, he must keep abreast of developments both technical and non-technical that will influence the future course of his product.

The engineering responsibility in a manufacturing company

GERHARDT STOLL
Director of Research
Whirlpool Corp.

The engineering responsibility includes new product planning in a durable consumer goods company where there are yearly model changes. The annual changes should be a combined responsibility of engineering and marketing. Engineering should be consistently ahead in new product development, so that marketing is in the position of choosing, rather than designing.

Control of new products or product changes by marketing alone may result in product planning based upon "catching up with competition." Too often decisions on new products or product lines may be made with the competition as a reference point, rather than the needs of the customer or useful available technology.

The position of engineering as related to research and marketing can be described as a part of a spectrum with over-lapping boundaries, but with clearly defined responsibilities that change during the process of product development. The process is described by means of a case history.

PSYCHROMETRIC CHART SYMPOSIUM—WEDNESDAY, FEBRUARY 3, 9:30 A.M.

P. N. VINTHER
Presiding Chairman

High altitude psychrometric charts

Increase in population and construction in the Southwestern United States, especially at military bases and atomic research installations, has led to a great increase in air conditioning installation in this area. Since a large area in New Mexico, Arizona, Utah and Colorado lies at elevations of from 4,000 to 8,000 ft, the sea-level ASHAE psychrometric chart is not usable.

There are various smaller charts, supplied by manufacturers, but none of the size and arrangement and usability of the ASHAE chart. It was felt that a set of high altitude charts to the same scale and arrangement as the ASHAE chart would improve the accuracy of air-conditioning design.

Since the Goff and Gratch tables in the GUIDE are for sea-level, it was necessary to calculate new tables from these for 26, 25, and 23 in. Hg. These values correspond to 3,850, 4,900, and 6,900 ft above sea level, which altitudes cover the more important localities in New Mexico and Colorado.

ROGER HAINES
Consulting Engineer
Bridgers and Paxton

The calculation and construction of these charts is a tedious job and for those who wish to construct charts for other altitudes, discussion of psychrometric theory and the method of construction will be presented.

The bases for all these calculations are the tables by Goff and Gratch in the 1955 Edition of the GUIDE, Chapter 3, Tables II and III.

Psychrometric chart for altitudes above sea level

During the past 50 years many psychrometric charts of various types have been published. At the present time the most commonly used charts are probably the Palmatier-Wile (Carrier Corp.) chart and the ASHAE chart. Both are excellent for sea-level pressure calculations.

The primary disadvantage of most presently-published psychrometric charts is their restriction to sea-level pressure problems. The Palmatier-Wile chart may be applied for elevations up to 5900 ft but the procedure for elevations above sea level is inconvenient.

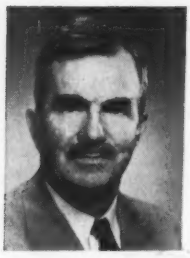
The purpose of this paper is to introduce a new psychrometric chart. The chart provides for solution of air-conditioning problems for barometric pressures from 10 to 14.696 psia and for dry-bulb temperatures from 0 to 120 F. The chart is of the Mollier type (basic coordinates of enthalpy and humidity ratio). It was constructed from psychrometric equations based on atmospheric air as a non-interacting mixture of dry air and water vapor.

Besides enthalpy and humidity ratio, the new chart includes the properties dry-bulb temperature, thermodynamic wet-bulb temperature, relative humidity, and volume. Six saturation curves covering the pressure range from 10 to 14.696 psia are shown. A protractor for the enthalpy-humidity-difference ratio (h_2-h_1/W_2-W_1) is included. The use of the new psychrometric chart is explained by several examples in the paper.

J. L. THRELKELD
Professor
Dept. of Mechanical Engineering
University of Minnesota

The paper also includes a review of several prior psychrometric charts. A summary of approximate psychrometric calculations is shown and comparisons are made with values from the tables of Goff and Gratch.

The psychrometric chart can be improved



C. M. ASHLEY
Chief Staff Engineer
Carrier Corp.
Member ASHRAE

A good psychrometric chart should be easy to understand, easy to use, correct thermodynamically and as complete as practicable. Neither the ASHAE nor the ASRE chart fully meets these requirements.

A chart is proposed which uses a conventional coordinate system, but with enthalpy at 0% humidity together with enthalpy deviation lines to adjust the enthalpy to the state point. Since the enthalpy deviation is identical with the enthalpy of water added or removed at the entering or leaving wet bulb temperature, the calculation of the heat of a process is substantially simplified.

The simple nature of the deviation term and its apparent relationship to the enthalpy of the moisture added or removed should also make the chart easier to understand.

Another possible arrangement of the chart which has certain advantages in the graphical solution of processes is to use dry bulb as abscissa and enthalpy as ordinate, resulting in nearly horizontal wet bulb lines and sloping humidity ratio lines.

A chart is also suggested for different barometric pressures which uses integral lines of enthalpy at 0% saturation and a series of saturation lines for the different altitudes together with a chart to indicate the enthalpy deviation and the enthalpy of moisture added or removed.

Psychrometric charts from the user's viewpoint

D. D. WILE
Vice Pres. and Chief Engr.
Recold Corp.
Member ASHRAE

Over the years psychrometric charts published by our two former Societies have run the gamut of size and arrangement, from those that were overly-simplified to those that were overly-complicated. The present Society chart, due to its large size, multiple folding and complex pattern of lines, is rarely used by engineers in their day-to-day work. Use of this chart appears to be confined to a very small percentage of our members. While the objectives of precision and accuracy are greatly to be recommended, we must not be carried away by such considerations to the point where we fail to serve the needs of our members.

After discussing psychrometric charts with many engineers who are required to use such charts in their day-to-day work, it is my conclusion that the Society should produce a chart having the following general characteristics:

The chart should be printed on a letter-size sheet, 8½ x 11 in., in a single color and on semi-transparent paper suitable for "blueprinting".

These charts should be made available in pads and carry the Society's name, along with space so that the user's name might also be imprinted.

Two temperature ranges will undoubtedly be required in order to cover both refrigeration and air conditioning applications.

Consideration should be given to separate charts for high altitudes, especially in the air conditioning range. The construction of as few as two, or possibly even one, chart for high altitude would satisfy a great need.

Enumerable expedients have been used over the years to present both wet bulb lines and enthalpy lines. At one extreme, the over-simplified charts show wet bulb lines as representing enthalpy lines and thus ignore the slight error involved. A more realistic approach appears to be the use of the wet bulb lines related to enthalpy at saturation. Some expedient may then be used to indicate the deviation between the wet bulb line and true enthalpy for those users who may be concerned.

It is my contention that a chart of this nature would find wide usage in our industry and, in making it available to our members, we would be providing them with a highly needed service.

Thermodynamic consistency in the presentation of psychrometric data

JOHN A. GOFF
Professor
School
of Mech. Engr.
University of Penna.

Just twenty years ago was begun, under a cooperative agreement with the American Society of Heating & Ventilating Engineers, a research investigation that produced the Goff-Gratch formulation of the thermodynamic properties of moist air which was subsequently adopted as international standard, pending new research, as being thermodynamically consistent within the accuracy of existing knowledge. The steam research program begun some twenty years earlier had pointed the way by its insistence upon the same criterion as the only acceptable basis for international agreement. In the case of the steam research program the violence that such insistence had to do to long cherished misconceptions of the old caloric theory was soon forgiven, and a remarkable growth of interest and understanding of thermodynamics, particularly among younger engineers, resulted from it.

Now facing the new Society is the opportunity to insist upon thermodynamic consistency within the accuracy of existing knowledge as an essential feature of its psychrometric chart or charts. A chart that, however accurate it may be, either lacks thermodynamic consistency or, having it, conceals it out of deference to tradition, is not likely to make a lasting contribution to the welfare of the profession that the Society represents. It is the object of the present paper to set forth some of the requirements of thermodynamic consistency that the new psychrometric chart or charts must meet to achieve relative permanence and accomplish sound educational objections.

FORUMS

Forums offer highly informal discussions for the exchange of ideas. There are no prepared papers or talks, no notes or minutes are taken, it is all "off the record." Our guests of the press respect the spirit of the forum. Here is an excellent oportunity to exchange and discuss ideas and opinions.

Six diversified subjects will be covered at the ASHRAE Dallas Semiannual Meeting. These were selected on the basis of popular interest expressed from various sources. The forums to be presented are as follows:

E. N. JOHNSON
Chairman
in Charge

Frozen Food Storage

E. J. ROBERTSON
Research Engineer
Wilson & Co.

Air Conditioning Automobiles

K. A. KOCH
Koch Engineering
& Sales Co.

Supply Air Systems

J. H. CLARKE
Visking Co.
Div. Union Carbide

Applications of Air-Cooled Condensers

D. E. KRAMER
Kramer-Trenton
Co.

Thermoelectric Effect

E. R. WOLFERT
Manager
Ref. & Env. Res.
Whirlpool Corp.

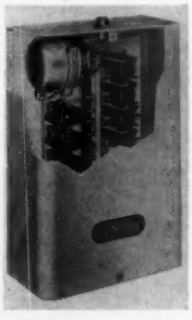
Piping and Pick-up Factors

L. E. SEELEY
President
H. B. Smith Co.

PARTS AND PRODUCTS

PRESSURE-ELECTRIC SWITCH

Adapted for use with unit ventilators having electric resistance heating elements, this control consists of a pneumatic motor which actuates a series of electric switches in response to a pneumatic signal. Normal supply pressure for this Multi-Step switch is 15 psi, with a maximum supply pressure of 25 psi. Switches are rated at 20 amp at 125, 250 and 460 volt ac, one hp at 115 volt ac, and two hp at 230 volt ac. Maximum ambient temp is 160 F.



Powers Regulator Company, 3434 Oakton St., Skokie, Ill.

NYLON AIR OUTLETS

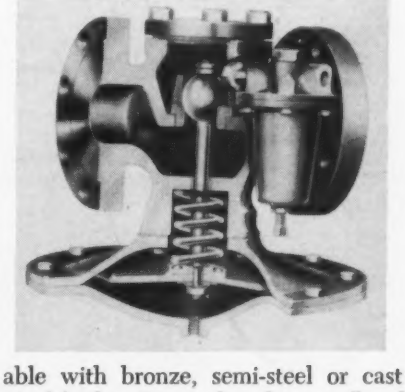
Offered under the name "Aristocrat 400 Series" are nylon injection-molded grilles, registers and curved blade diffusers, cited as being non-combustible, heat resistant to 300 F, distortion free at high temperatures, non-corrosive, virtually static-free and permitting higher jet velocities without whistling or roaring.

Grilles are available in single and double deflection types with individually adjustable air-foil bars. Standard sizes are offered, with choice of either vertical or horizontal bar mountings. Registers come in multi-louver and opposed blade damper types, for both commercial and year-round residential requirements.

Airguide Plastics Corporation, 20 S. E. Third Ave., Miami 32, Fla.

PRESSURE REDUCING VALVE

Manufactured in sizes from three-quarters to four in., this valve is available with bronze, semi-steel or cast steel body. Screwed ends are offered in sizes up to three in., and flanged bodies from one and one-quarter to four in.



Cited as meeting all requirements for use at most steam pressure reducing valve installations, the KP-4 is an external pilot-operated valve featuring a stainless steel ball inner valve, which closes against a monel seat ring.

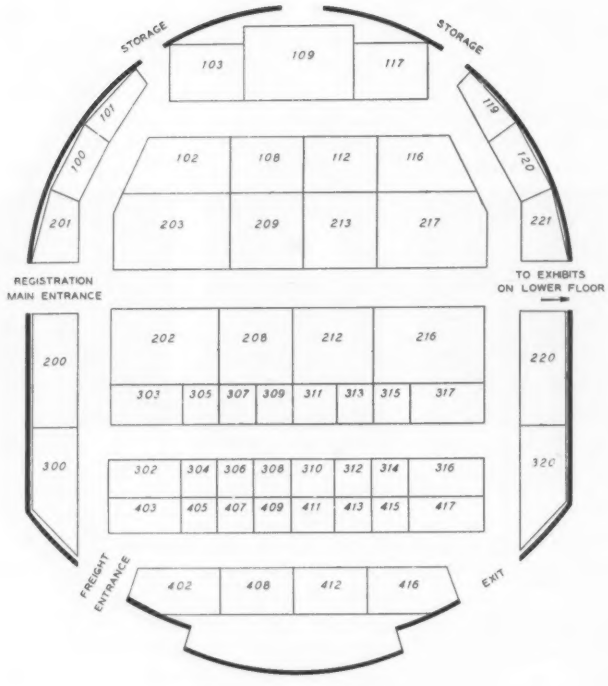
Klipfel Valves, Inc., 1075 Lincoln Ave., Hamilton, Ohio.

FROST PREVENTION

For preventing frost accumulation on the refrigerated coils of large-scale commercial freezing and cold storage installations, with convenient disposal of the condensed moisture, No-Frost Concentrator has been introduced. A non-freezing hygroscopic liquid is sprayed over the cold coils of a fan cooler, absorbing the moisture as fast as the coils condense it. As this condensate water dilutes the absorbent solution to the point where freezing becomes possible, the strength of the solution may be restored by the concentrator, which adapts a submerged electric water heater to provide sufficient heat to evaporate the water while the reconcentrated liquid is returned.

Niagara Blower Company, 405 Lexington Ave., New York 17, N. Y.

2nd Southwest Heating and A



ARENA FLOOR

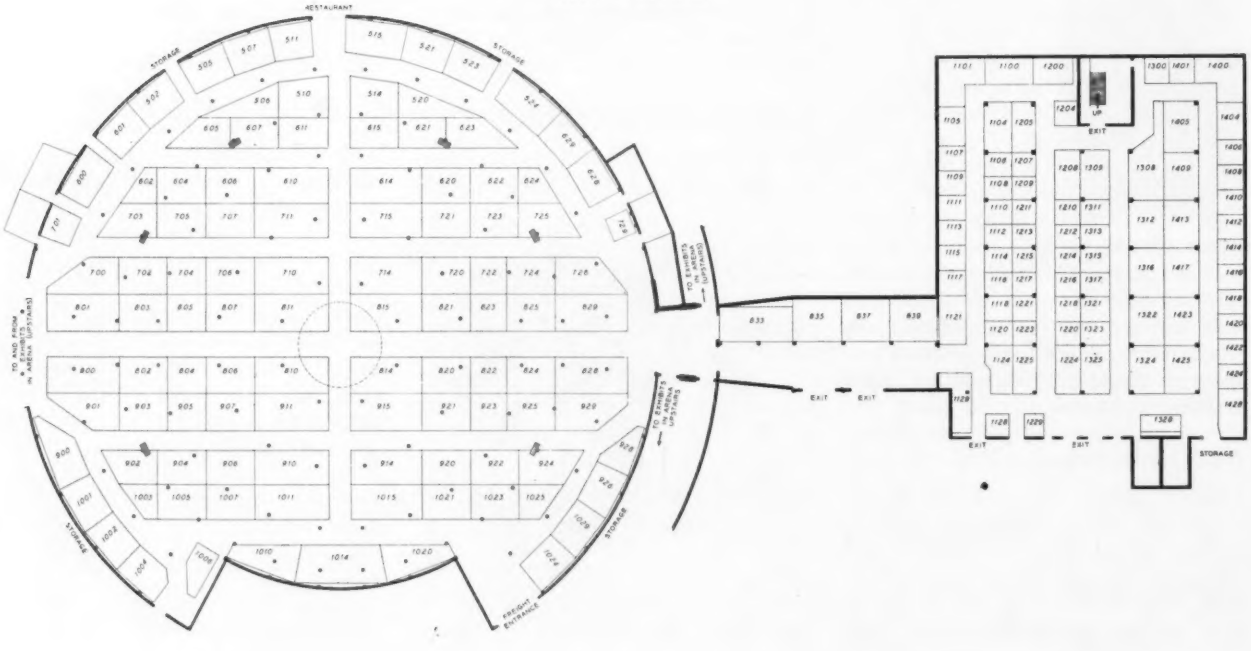
The following list of exhibitors at the 2nd Southwest Heating and Air-Conditioning Exposition is keyed to the floor space occupied at the Dallas Memorial Auditorium by those booth numbers also shown on the floor plan of exhibits.

Show hours are: 12:00 noon to 10:00 p.m. daily, February 1 through 4.

Exhibits will feature equipment adapted to the climate, thereby demonstrating one of the great growth factors of the industries represented—their ability to balance out the effects of unpleasant weather in any climate by the simplest adaptations of their basic designs.

Above normal temperatures are characteristic of the southwestern climate and the Exposition will present, among other innovations, new adaptations of evaporative cooling. By contrast, sudden dips into the lows produce a sharply defined, intermittent heating problem, and the year-round air-conditioning system, as typified by the heat pump, will be a significant feature of the display, as will many supplementary heating units.

FIRST FLOOR



Air-Conditioning Exposition

will be held in the Dallas Memorial Auditorium coincidentally with the ASHRAE Semiannual Meeting, February 1-4, 1960. Featured will be the equipment and components offerings of 200 manufacturers in the fields of heating, refrigerating, air conditioning and ventilating.

Heat pumps will be featured by several exhibitors, along with both remote and self-contained air-conditioning units. One will introduce completely new models of air conditioners and heat pumps, as well as a new line of compact forced-air furnaces. Another offers a remote condenser unit designed to provide high economy at high ambient temperatures. A manufacturer of 2 to 10-ton remote air conditioners and heat pumps provides water cooled condensing units of high capacity and low operating cost.

Included will be a packaged 50-ton air conditioner with in-built evaporative condenser, which may be installed inside a building as a self-contained unit, or set up independently, completely exposed, but requiring no penthouse or other covering. All starters and controls are assembled inside the enclosure and the unit is shipped ready for connection to ductwork, plumbing and electric lines.

One line of packaged liquid chillers with optional condenser units is available in sizes up to 125-ton. There are matched components to handle 70,000 to 200,000 Btu heating loads and cooling loads in a range of 22,000 to 60,000 cfm with remote air cooled condensers, operating at ambients of 125 F.

One exhibitor, specializing in the air conditioning of churches, lodge halls, funeral homes and public auditoriums, where high peak loads prevail for only a few hours at a time and at intervals, displays a "cold storage" unit consisting of a stack of refrigeration coils enclosed in a heavily insulated tank. Refrigeration is furnished by a relatively small compressor unit operating continuously. On demand, water is pumped through the storage tank to radiation in the several distributing zones. Boiler water may be circulated through the same piping system to pick up the heating load.

The Exposition will reveal a miscellany of attic fans, roof ventilators and other air moving equipment featuring, variously, compact package design, all aluminum construction or quiet performance.

	(Booth No.)
A.-J. MFG. CO. 3601 East 18th St., Kansas City 27, Mo.	1100
ACME ENGINEERING & MFG. CORP. Muskogee, Okla.	833
ACME INDUSTRIES, INC. 600 N. Mechanic St. Jackson, Mich.	515, 521, 523
AIMCO PRODUCTS CORP. (SUBSIDIARY OF YUBA CONSOLIDATED INDS., INC.) 801 West 21st St., Tulsa, Okla.	728
AIR CONDITIONING, HEATING AND REFRIGERATION NEWS 450 West Fort St., Detroit 26, Mich.	1312
AIR CONDITIONING INDUSTRIES, INC. P. O. Box 6602, Houston 5, Texas	1223
AIR DEVICES, INC. 185 Madison Ave., New York 16, N. Y.	1110
AIR ENGINEERING 450 West Fort St., Detroit 26, Mich.	1209
AIR GUIDE PLASTICS CORP. 20 S. E. 3rd Ave., Miami, Fla.	605
AIRSERCO MFG. CO., INC. 435 Melwood St., Pittsburgh 13, Pa.	1120
AIRTEMP DIV. CHRYSLER CORP. Dayton 1, Ohio	620, 622, 723
AJAX BOILER & HEATER CO. 1519 W. 132 St., Gardena, Calif.	835, 837, 839
ALCO VALVE CO. 65 Kingsland, St. Louis 5, Mo.	906

ALLIS-CHALMERS MFG. CO. 200
Box 512,
Milwaukee 1, Wisc.

ALTON MFG. CO. 403
1112 Ross Ave.,
Dallas 2, Texas

AMERICAN AIR FILTER CO., INC. 524, 628, 629
215 Central Ave.,
Louisville 8, Ky.

AMERICAN ARTISAN 407
6 N. Michigan Ave.,
Chicago 2, Ill.

AMERICAN FURNACE CO. 315, 317
1300 Hampton Ave.,
St. Louis 10, Mo.

AMERICAN GAS ASSN. 1005
420 Lexington Ave.,
New York 17, N. Y.

AMERICAN METAL MFG. CO. 405
Main & College,
Farmersville, Texas

AMERICAN METER CO., INC. 820
4400 Forest Lane,
P. O. Box 306, Garland, Texas

AMERICAN SOCIETY OF HEATING REFRIGERATING AND AIR-CONDITIONING ENGINEERS, INC. 220
234 Fifth Ave.,
New York 1, N. Y.

AMERICAN-STANDARD, DETROIT CONTROLS DIV. 805
INDUSTRIAL DIV. 907, 911
Detroit 32, Mich.

AMERIVENT (DIV. OF AMERICAN METAL PRODS. CO., INC.) 702
6100 Bandini Blvd.,
Los Angeles 22, Calif.

AMMERMAN CO. INC. 221
P. O. Box 182,
Stillwater, Minn.

ANEMOSTAT—WATERLOO 102
10 E. 39th St.,
New York 16, N. Y.

ANSUL CHEMICAL CO. 117
Marinette, Wisc.

ARKLA AIR CONDITIONING CORP. 910
Shannon Bldg., 812 Main St.,
Little Rock, Ark.

ARMSTRONG CORK CO. INSULATION DIV. 720
West Liberty St.,
Lancaster, Pa.

ARROW-HART & HEGEMAN ELECTRIC CO. 1213
103 Hawthorne St.,
Hartford 6, Conn.

AUTO-FLO CORP. 1409
12085 Dixie St.,
Detroit 39, Mich.

AUTOMATIC DEVICES CO. INC. 101
714 Hillgrove Ave.,
Western Springs, Ill.

BALTIMORE AIRCOIL CO. INC. 408, 412
P. O. Box 7322,
Baltimore 27, Md.

BARBER-COLMAN CO. 705, 707
1300 Rock St.,
Rockford, Ill.

BAR-BROOK MFG. CO. INC. 902
6135 Linwood Ave.,
P. O. Box 6638,
Shreveport, La.

BARKE PRODUCTS, INC. 729
501 Vineland Road,
Bay Village, Ohio

BASO, INC. 1418, 1420
730 No. Jackson St.,
Milwaukee 1, Wisc.

BELL & GOSSETT CO. 416
Morton Grove, Ill.

BOWMAN CO., D. F. 1406
315 West Main,
New Albany, Ind.

BREIDERT CO., G. C. 835, 837, 839
P. O. Box 1190,
San Fernando, Calif.

BRYANT MFG. CO. (DIV. OF CARRIER CORP.) 1011
2020 Montcalm St.,
Indianapolis, Ind.

CARRIER CORP. 1010, 1014, 1020
Carrier Parkway,
Syracuse 1, N. Y.

CHATTANOOGA ROYAL CO. 409, 411, 413, 415
Chattanooga 6, Tenn.

CHICAGO BLOWER CORP. 1124, 1225
9867 Pacific Ave.,
Franklin Park, Ill.

CHRYSLER CORP., AIRTEMP DIV. 620, 622, 723
Dayton 1, Ohio

CLEAVER BROOKS CO. 624
326 E. Keefe Ave.,
Milwaukee 12, Wisc.

COBELL IND., INC. 806
P. O. Box 891,
Cleburne, Texas

COLEMAN CO., INC. 801
Wichita 1, Kansas

CONGRESS DRIVES (DIV. OF TANN CORP.) 621
3750 E. Outer Drive,
Detroit 34, Mich.

CONTINENTAL AIR FILTERS, INC. 835, 837, 839
2520 Helm St.,
P. O. Box 1647,
Louisville 1, Ky.

CONTROLS CO. OF AMERICA 822
9555 Soreng Ave.,
Schiller Park, Ill.

COOK CO., LOREN 103
Berea, Ohio

COOLERATOR DIV. McGRAW-EDISON CO. 800
McGraw-Edison Co.
704 No. Clark,
Albion, Mich.

COPELAND REFRIGERATION CORP. 216
Sidney, Ohio

CRANE CO. 202
836 So. Michigan Ave.,
Chicago 5, Ill.

CURTIS MFG. CO. REFRIGERATION DIV. 320
1905 Kienlen Ave.,
St. Louis 20, Mo.

DALLAS POWER & LIGHT CO. 810
Dallas, Texas

DAY & NIGHT MFG. CO. 502, 601
855 Anaheim-Puente Road,
La Puente, Calif.

DETROIT CONTROLS (DIV. OF AMERICAN-STANDARD) 805
5900 Trumbull Ave.,
Detroit 8, Mich.

DRAYER-HANSON (DIV. OF NATIONAL-U. S. RADIATOR CORP.) 1129
P. O. Box 2215,
Terminal Annex,
Los Angeles 54, Calif.

DRYOMATIC CORP. 1118
Alexandria, Va.

DUNHAM-BUSH, INC. 203, 209
179 South St.,
West Hartford, Conn.

DUPONT DE NEMOURS & CO., E. I. 1104, 1106
Wilmington 98, Del.

DURA-VENT CORP. 1015
1400 W. Ormsby St.,
Louisville 10, Ky.

DURO DYNE CORP. 1113
Route 110,
Farmingdale, N. Y.

ECONO PRODUCTS CO., INC. 606
East Haddam, Conn.

EDWARDS ENG. CORP. 109
101 Alexander Ave.,
Pompton Plains, N. J.

EGGELHOF ENGINEERS INC. 1224
P. O. Box 1743,
1912 Hussion St.,
Houston, Texas

ELECTRIC HEAT AND AIR CONDITIONING 1300
2 W. 45th St.,
New York 36, N. Y.

ELECTRO-AIR CLEANER CO. 835, 837, 839
Olivia & Sproul Sts.,
McKees Rocks, Pa.

EMERSON ELECTRIC MFG. CO. 1321
8100 Florissant Ave.,
St. Louis 21, Mo.

ENGELHARD IND., INC. HANOVIA LAMP DIV. 1221
100 Chestnut St.,
Newark 5, N. J.

FAIRBANKS CO. 1109
393 Lafayette St.,
New York 3, N. Y.

FANJET ROOF COOLING (DIV. OF MUELLER-MIST IRRIGATION CO.) 310
P. O. Box 471,
Maywood, Ill.

Memorial Auditorium will be a focus for members and guests attending a sell-out exhibition of equipment and components for heating, refrigerating, air-conditioning and ventilating purposes with regional adaptations

FARR CO. 829
2301 Rosecrans Ave.,
El Segundo, Calif.

FLANDERS FILTERS, INC. 1425
P. O. Box 718,
Riverhead, N. Y.

FELTER CO., JOHN 701
1309 Ashland,
Houston, Texas

FLEXIBLE TUBING CORP. 305
Guilford, Conn.

FLUOR PRODUCTS CO. 300
12000 E. Washington Blvd.,
Whittier, Calif.

FRASER & JOHNSTON CO. 914
1900 17th St.,
San Francisco 3, Calif.

FURNAS ELECTRIC CO. 722
100 McKee St.,
Batavia, Ill.

GANNON CO., RUSSELL R. 703
5537 Vine St.,
Cincinnati 16, Ohio

GAS HEAT & COMFORT COOLING 1328
2 W. 45th St.,
New York 36, N. Y.

GENERAL CHEMICAL DIV., ALLIED CHEMICAL CORP. 1324
40 Rector St.,
New York 6, N. Y.

GENERAL CONTROLS CO. 904
801 Allen Ave.,
Glendale 1, Calif.

GENERAL ELECTRIC CO., APPARATUS SALES DIV. 1021
1 River Road,
Schenectady, N. Y.

GENERAL PRODUCTS CO., INC. 309
Fredericksburg, Va.

GOODFELLOW CO. INC., E. D. 611
496 S. Bodley Ave.,
Memphis 6, Tenn.

GORDON & PIATT, INC. 201
P. O. Box 914,
Winfield, Kansas

GREENHECK FAN & VENTILATOR CORP. 1116
Schofield, Wisc.

GREGORY INDUSTRIES 1313, 1315, 1317
28th St. & Toledo Ave.,
Lorain, Ohio

GUSTIN-BACON MFG. CO. 600
210 West Tenth St.,
Kansas City 5, Mo.

HALSTEAD & MITCHELL 926
Bessemer Building,
Pittsburgh 22, Pa.

HANOVIA LAMP (DIV. OF ENGELHARD INDS. INC.) 1221
100 Chestnut St.,
Newark 5, N. J.

HART & COOLEY MFG. CO. 1023
500 East 8th St.,
Holland, Mich.

HEATING, PIPING AND AIR CONDITIONING 407
6 No. Michigan Ave.,
Chicago 2, Ill.

HENRY FURNACE CO. 217
Medina, Ohio

HENRY VALVE CO. 312, 314
3215 North Ave.,
Melrose Park, Ill.

HOLLY-GENERAL CO. 520
875 South Arroyo Parkway,
P. O. Box 2098-D,
Pasadena, Calif.

HUBBELL CORP. 1417
407 E. Holly Road,
Mundelein, Ill.

I.C.E.D. INC. 1400
P. O. Box 10515
St. Petersburg, Fla.

ILG ELECTRIC VENTILATING CO. 920, 922
2850 Pulaski Road,
Chicago 41, Ill.

ILLINOIS TESTING LABORATORIES, INC. 1210, 1212
420 N. LaSalle St.,
Chicago 10, Ill.

INDUSTRIAL ACOUSTICS CO. 1323
341 Jackson Ave.,
New York 54, N. Y.

INDUSTRIAL COMBUSTION, INC. 802
4507 N. Oakland Ave.,
Milwaukee 11, Wisc.

INDUSTRIAL DIV. AMERICAN-STANDARD 907, 911
Detroit 32, Mich.

INGERSOLL-RAND CO. 815
11 Broadway,
New York 4, N. Y.

INTERNATIONAL MFG. CO. 828
600 E. Grand,
Oklahoma City, Okla.

INTERNATIONAL METAL PRODUCTS SALES CORP. 602, 604
500 South 15th St.,
P. O. Box 1712,
Phoenix, Ariz.

JACKES-EVANS MFG. CO. 307
4427 Geraldine Ave.,
St. Louis 15, Mo.

JANITROL HEATING & AIR CONDITIONING (DIV. OF MIDLAND-ROSS CORP.) 714
400 Dublin Ave.,
Columbus 16, Ohio

JENN AIR PRODUCTS CO., INC. 623
1102 Stadium Drive,
Indianapolis 7, Ind.

JOHNS-MANVILLE SALES CORP. 402
22 E. 40th St.,
New York 16, N. Y.

JOHNSON SERVICE CO. 108, 112, 116
507 E. Michigan St.,
Milwaukee, Wisc.

JOINER-MEADE-CAPERS, INC. 835, 837, 839
3920 Cedar Springs,
Dallas, Texas

KSM PRODUCTS, INC. 1208
Merchantville 8, N. J.

KEENEY PUBLISHING CO. 407
6 North Michigan Ave.,
Chicago 2, Ill.

KORFUND CO. 835, 837, 839
48-15 32nd Place,
Long Island City 1, N. Y.

KRUEGER AIR CONDITIONING CO. 100
19 E. Rillito St.,
Tucson, Ariz.

LIMA REGISTER CO. 1309
1790 No. Cable Rd.,
Lima, Ohio

LOCKFORMER CO. 1205
4615 W. Roosevelt Rd.,
Chicago 50, Ill.

LONE STAR GAS CO. 1005
301 South Harwood St.,
Dallas 1, Texas

MCDONNELL & MILLER 804
3500 N. Spaulding Ave.,
Chicago 18, Ill.

McGRAW-EDISON CO. COOLERATOR DIV. 800
704 No. Clark,
Albion, Mich.

MCQUAY, INC. 208, 212
1600 Broadway, N.E.,
Minneapolis 13, Minn.

MAGIC AIRE (DIV. OF UNITED ELEC. CO.) 928
500 Block Galveston,
P. O. Box 119,
Wichita Falls, Texas

MAJOR CONTROLS CO. 823
Highway 71 at Yorba Road,
Corona, Calif.

MARLEY CO. 814
222 West Gregory Blvd.,
Kansas City 14, Mo.

MARLO COIL CO. 700
7100 South Grand Ave.,
St. Louis 11, Mo.

METAL MFG. CO. 1111
114 N.W. 5th St.,
Fort Lauderdale, Fla.

METALBESTOS (DIV. OF WM. WALLACE CO.) 313
Belmont, Calif.

MILWAUKEE ELECTRIC TOOL CORP. 1114
5316 W. State St.,
Milwaukee 8, Wisc.

MINE SAFETY APPLIANCES CO. 302
201 N. Braddock Ave.,
Pittsburgh 3, Pa.

MINNEAPOLIS-HONEYWELL REGULATOR CO. 1024, 1029
Commercial Div.,
2753 Fourth Ave. So.,
Minneapolis 8, Minn.

MONOGRAM INDS., INC. 721
825 South Front St.,
Quincy, Ill.

MORRISON PRODS., INC. 615
16816 Waterloo Road,
Cleveland 10, Ohio

MUELLER BRASS 1413
Port Huron, Mich.

MUELLER CLIMATROL (DIV. OF WORTHINGTON CORP.) 921, 923
2005 W. Oklahoma Ave.,
Milwaukee 15, Wisc.

MUELLERMIST IRRIGATION CO., FANJET ROOF COOLING DIV. 310
P. O. Box 471,
Maywood, Ill.

MULTI-VENT DIV., PYLE-NATIONAL CO. 1121
1334 No. Kostner Ave.,
Chicago 51, Ill.

NATIONAL-U. S. RADIATOR CORP. DRAYER-HANSON DIV. 1129
P. O. Box 2215 Terminal Annex,
Los Angeles 54, Calif.

VIKING AIR PRODUCTS DIV. 311
5601 Walworth Ave.,
Cleveland 2, Ohio

NORMAN PRODUCTS CO. 900
1150 Chesapeake Ave.,
Columbus 12, Ohio

NORTHWEST FOUNDRY & FURNACE CO. 1311
2345 S.E. Gladstone St.,
Portland 2, Ore.

OLSEN MFG. CO., C. A. 217
Elyria, Ohio

OMARK INDUSTRIES, INC. 1405
9701 S.E. McLoughlin,
Portland 22, Ore.

OWENS-CORNING FIBERGLAS CORP. 821
National Bank Bldg.,
Toledo 1, Ohio

PALMER MFG. CORP. 1414
2200 W. Filmore
Phoenix, Ariz.

PAYNE CO. 903
855 Annaheim-Puente Rd.,
La Puente, Calif.

PEERLESS MFG. (DIV. OF DOVER CORP.) 1015
1400 W. Ormsby St.,
Louisville 10, Ky.

PENN CONTROLS, INC. 724
Goshen, Ind.

PERFECTION INDS. (DIV. OF HUPP CORP.) 901
1135 Ivanhoe Road,
Cleveland 10, Ohio

POWDER TOOL SUPPLY INC. 1405
1305 So. Akard St.,
Dallas, Texas

PROCESS SOLVENT CO. 1229
1040 Chelsea Traffic Way,
Kansas City, Kansas

PYLE NATIONAL CO. MULTI-VENT DIV. 1121
1334 N. Kostner Ave.,
Chicago 51, Ill.

RANDALL GRAPHITE BEARINGS, INC. 304, 306
Lima, Ohio

RAYPAK CO., INC. 824
2416 Chico Ave.,
El Monte, Calif.

READY-POWER CO. 1007
11231 Freud Ave.,
Detroit 14, Mich.

RECOLD CORP. 119, 120
7250 E. Slauson Ave.,
Los Angeles 22, Calif.

REED UNIT-FANS, INC. 1025
501 N. Saint Patrick St.,
New Orleans 19, La.

REFRIGERATION AND AIR CONDITIONING BUSINESS 1422
812 Huron Rd.,
Cleveland 15, Ohio

RESEARCH PRODUCTS CORP. 803
1015 East Washington Ave.,
Madison 10, Wisc.

RHEEM MFG. CO. 915
7600 S. Kedzie Ave.,
Chicago 29, Ill.

RICH FAN MFG. CO., PHIL 1204
2900 Caroline St.,
P. O. Box 8036,
Houston 4, Texas

RIDGE TOOL CO. 1004
Elyria, Ohio

ROBERTSON CO., H. H. 704
2400 Farmers Bank Bldg.,
Pittsburgh 22, Pa.

ROTHERM ENGINEERING CO., INC. 1003
7280 West Devon Ave.,
Chicago 31, Ill.

SCHEMENAUER MFG. CO. 1424, 1428
Holland, Ohio

SCHNACKE, INC. 308
1101 N. Governor,
Evansville 7, Ind.

SMITH CORP., A. O. 610
Milwaukee 1, Wisc.

SOUTHWEST MFG. CO. 614
Aurora, Mo.

SOUTHWEST REFRIGERATION WHOLESALERS ASSN., INC. 1006
Dallas, Texas

SPORLAN VALVE CO. 1001
7525 Sussex Ave.,
St. Louis 17, Mo.

SPRAGUE ELECTRIC CO. 1128
North Adams, Mass.

STEWART-WARNER CORP. 1325
Heating & Air Conditioning Div.
Lebanon, Ind.

STODDARD INDUSTRIES INC. 1408
3383 E. Layton Ave.,
Cudahy, Wisc.

STRUTHERS-WELLS CORP., TITUSVILLE IRON WORKS CO. DIV. 1316, 1322
Titusville, Pa.

TANN CORP., CONGRESS DRIVES DIV. 621
3750 E. Outer Drive,
Detroit 34, Mich.

TEXAS INFRA RED RADIANT CO. 1101
2400 O.S.T. P. O. Box 1308
Houston 1, Texas

TEXAS PRODUCTS MFG. CO. 607
P. O. Box 571,
Waco, Texas

TEXAS REFRIGERATION & ENG. CO. 1211
158 Express Street,
Dallas 7, Texas

THERMAC CO. 510
14296 East 6th St.,
Corona, Calif.

THERMAL ENG. CORP. 213
P. O. Box 13254,
Houston 19, Texas

THERMO-PAK BOILERS, INC. 1108
404 So. Palm Ave.,
Alhambra, Calif.

TITUSVILLE IRON WORKS CO. (DIV. OF STRUTHERS-WELLS CORP.) 1316, 1322
Titusville, Pa.

TORRINGTON MFG. CO. 303
70 Franklin St.,
Torrington, Conn.

TRANE CO. 505, 507, 511
La Crosse, Wisc.

H. O. TRERICE CO. 1207
1420 W. Lafayette Blvd.,
Detroit 16, Mich.

TRION, INC. 1112
1000 Island Ave.,
McKees Rocks, Pa.

TUBENFIL COIL CO., INC. 1215, 1217
P. O. Box 5445,
Houston 12, Texas

H. W. TUTTLE & CO. 1401
Tecumseh, Mich.

UNION CARBIDE & CHEMICAL CO. (DIV. OF UNION CARBIDE CORP.) 1416
30 E. 42nd St.,
New York 17, N. Y.

UNITED SHEET METAL CO. 1002
540 South Drexel Ave.,
Columbus 9, Ohio

UNITED STATES AIR CONDITIONING CORP. 905
P. O. Box 360,
Delaware, Ohio

UNITED STATES REGISTER CO. 316
Battle Creek, Mich.

UTILITY APPLIANCE CORP. 715
4851 South Alameda St.,
Los Angeles 58, Calif.

UTILITY FAN CORP. (DIV. OF UTILITY APPLIANCE CORP.) 711
911 E. 59th St.,
Los Angeles 1, Calif.

VAN-PACKER CO. (DIV. OF FLINTKOTE CO.) 1200
1232 McKinley Ave.,
Chicago Heights, Ill.

VENTCO, INC. 1204
1210 Tuam Street,
P. O. Box 8036,
Houston 4, Texas

VIBRATION MOUNTINGS, INC. 506
98-25 50th Ave.,
Corona, N. Y.

VIKING AIR PRODUCTS (DIV. OF NATIONAL-U. S. RADIATOR CORP.) 311
5601 Walworth Ave.,
Cleveland 2, Ohio

VILTER MFG. CO. 1105
Milwaukee 7, Wisc.

WALLACE CO., WM., METALBESTOS DIV. 313
Belmont, Calif.

WARD CO., L. R. 1115, 1117
3009 Canton St.,
Dallas 26, Texas

WARREN REGISTER & GRILLE, INC. 1107
3680 N.W. 50th St.,
Miami, Fla.

WATERLOO REGISTER CO. 102
P. O. Box 72
Waterloo, Iowa

WESTERN SUPPLY CO. 1214, 1216
Box 784,
Hutchinson, Kansas

WESTINGHOUSE ELECTRIC CORP. AIR CONDITIONING DIV. 514
Staunton, Va.

GATEWAY CENTER 825
401 Liberty Ave.,
P. O. Box 868,
Pittsburgh 30, Pa.

WHEEL TRUEING TOOL CO. 1410, 1412
3200-3220 W. Davison Ave.,
Detroit 38, Mich.

WHITE RODGERS CO. 1308
1209 Cass Ave.,
St. Louis 6, Mo.

WIEGAND CO., EDWIN L. 1115, 1117
Pittsburgh, Pa.

WIGGIN PRODUCTS CO., INC. 924
50 Terminal St.,
Boston 29, Mass.

WING MFG. CO., L. J. (DIV. OF AERO SUPPLY MFG. CO. INC.) 1218, 1220
50 Vreeland Mills Road,
Linden, N. J.

WORTHINGTON CORP. 925, 929
Ampere Station,
East Orange, N. J.

YEATS APPLIANCE DOLLY SALES CO. 417
2124 N. 12th St.,
Milwaukee 5, Wisc.

YORK CORP. 706, 710, 807, 811
York, Pa.

YUBA CONSOLIDATED INDUSTRIES, INC. 725
1275 California Ave.,
Palo Alto, Calif.

Matching

Home air conditioning

energy requirements and the weather

R. B. JOPLIN

E. H. MUEHLHAUSE

"It is difficult to compare home air conditioning installations and conditions due to individual peculiarities of the owner with respect to thermostat setting, time of operation and other factors . . ." Here, the authors have used one community's average gas consumption as the base load for all air conditioning customers; applied the Degree Day Deficiency relationship which avoids those peculiarities of the owner and relies on the practice of the average customer, and thus correlated residential air conditioning energy requirements with atmospheric conditions.

Many investigators have attempted correlation of residential cooling energy requirements with atmospheric conditions. All such efforts, of which we are aware have been based on either a single, or at most a few, individual samples. Correlation has been difficult – due to individual peculiarities of the home owner with respect to thermostat setting, time of operation, and other factors. The general applicability of the Degree Day Deficiency relationship to energy required for residential heating generally avoids the peculiarities of the individual sample and relies on the practice of the average customer.

It was hoped that analysis of average usage by groups of gas air conditioning customers large enough to be statistically significant might be meaningful. This approach could be made by deducting estimated base gas load from monthly bills rendered residential air conditioning customers, and correlating the apparent net average usage of gas for air conditioning with pertinent atmospheric conditions that were experienced during the specific period being investigated. As all residential bills are rendered on approximately a monthly basis, the month is the smallest unit useful toward this correlation.

R. B. Joplin is a Mathematician and E. H. Muehlhause a Research Engineer, Lone Star Gas Company.

The raw data did not include any differentiation between use of gas for air conditioning and use of gas for other purposes in the residence. So the first problem was determination of base load. Our sales of gas-fired central residential air conditioning units have been only to owners in the higher income brackets. As there is the possibility that base load may vary with income, an analysis of average gas consumption per customer during the summer months was made. Highland Park is a residential area containing 3250 customers, entirely surrounded by the city of Dallas, in which the average income is well above that of the average in the city of Dallas. University Park is another similar area. Fruitdale and Cockrell Hill are two suburban areas of low average income.

Fig. 1 shows data on average consumption of gas for all uses except air conditioning plotted against the month of the year. University Park closely followed Dallas consumption, and is not shown separately. Note that Highland Park's average gas usage is 0.5 to 1.0 Mcf per month higher than Dallas' average. Highland Park's average gas consumption was used as the average base load for all air conditioning customers.

Degree Day Excess. For correlation attempts in this examination, the daily average temperature concept with a base temperature of 65 F was used. This will be referred to as the Degree Day Excess, or DDE, and is the Degree Day Deficiency multiplied by –1. This is done simply so that the DDE's will be positive.

The equation for calculating DDE's by this method is:

$$DDE = \tfrac{1}{2} (T_{max} + T_{min}) - 65$$

Fig. 2 provides data for 48 residential air conditioning customers selected at random. The DDE scale shows the total number of DDE's experienced during each billing period of approximately 30 days and therefore excludes one area of particular interest, which is the intercept of the curve showing gas consumption with the DDE axis. The high degree of scatter confirms previous comments about difficulties that arise from study of individual samples.

A sample of 130 three-ton cus-

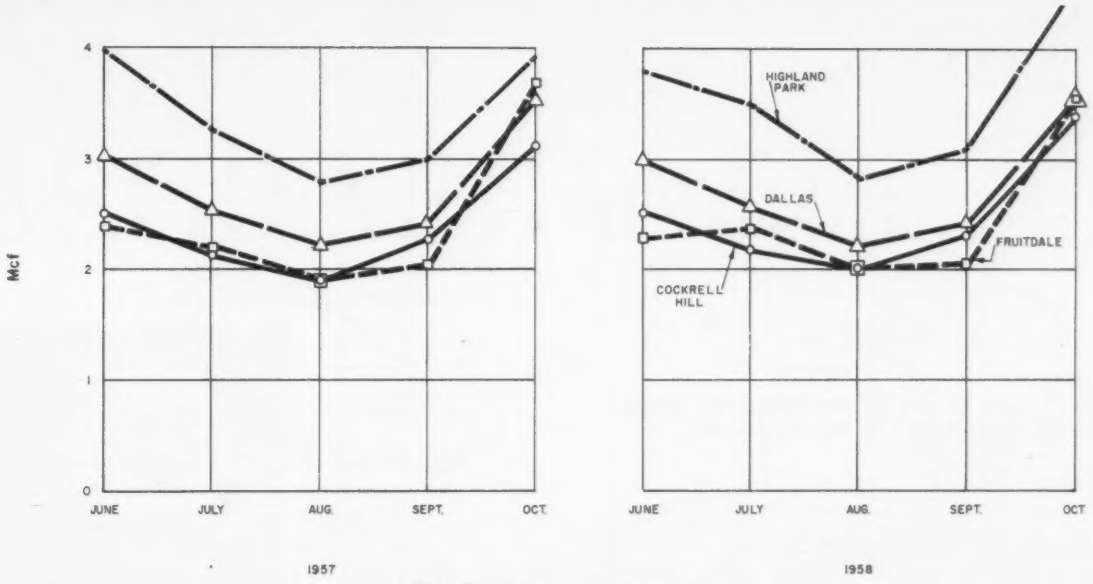


Fig. 1 Average consumption (Mcf) per month per non-air conditioning customer

tomers was chosen. The data were evaluated as follows:

1. Average gas consumption $= \frac{\Sigma\,(g - b)}{n}$

2. Average DDE's $= \frac{\Sigma\,d}{n}$

g = gas used by each customer, 1060—1100 Btu per cu ft
n = number of customers
b = base load (as determined from Fig. 1 data for Highland Park)
d = total DDE's occurring during the billing period for each customer, as determined from U. S. Weather Bureau records.

Average gas consumption was calculated for each of the cooling months indicated above for 1957 and 1958. Average consumption was plotted against the corresponding number of DDE's as shown on Fig. 3.

Calculations were then repeated on another sample of 330 five-ton units. These data were plotted on Fig. 4. Figs. 3 and 4 show a relatively minor scatter of points representing monthly averages and confirm the practicalities of the DDE as defined above for correlation of energy consumption of absorption type central residential air conditioning units with atmospheric conditions in the Dallas area.

It is interesting to note the intercept of the gas consumption line with the DDE axis. It is obvious that the selection of any base temperature other than 65 F would change this intercept unfavorably.

This correlation is based on actual consumption of energy after installation of the central residential unit. It does not consider the once-called "Discomfort Index," which Index may be assumed to control individual house owners' decisions as to installation of summer air conditioning equipment. Once the installation has been made and placed in operation, it is our opinion that the amount of energy consumed by the installation is controlled by the thermostat. Therefore, energy consumption is governed primarily by the sensible heat gain of the residence.

The rate of gain of sensible heat is primarily determined by the difference between ambient and internal dry bulb temperatures, and only to a minor degree by the effects of solar radiation. Humidity would have little or no effect. For these reasons, the correlation of energy requirements with average dry bulb temperatures as presented in Figs. 3 and 4 appears to be reasonably consistent with theoretical considerations. Data presented in Figs. 3 and 4 pertain to average gas consumption in residences supplied with three-ton gas-fired air conditioners in the case of Fig. 3, and with five-ton gas-fired air conditioners in the case of Fig. 4.

These curves have direct meaning only for these specific types

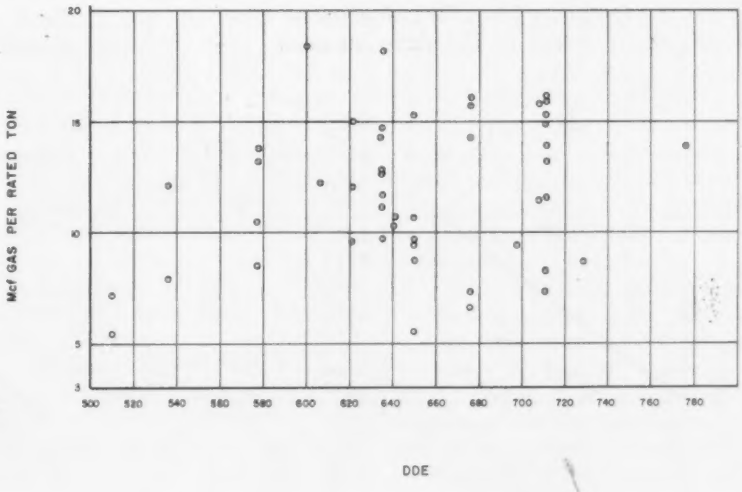


Fig. 2 Use of gas for residential air conditioning; 48 customers, July 1957

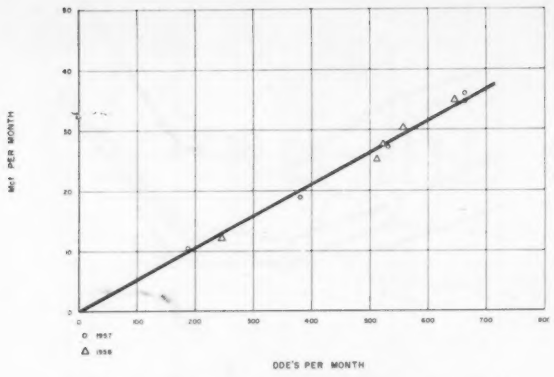


Fig. 3 Use of gas for residential air conditioning; average of 130 three-ton units

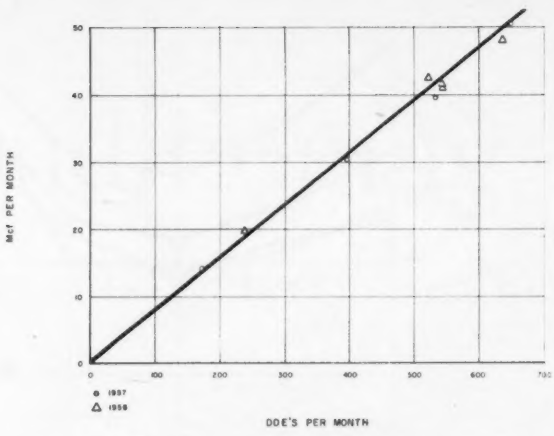


Fig. 4 Use of gas for residential air conditioning; average of 330 five-ton units

of residential air conditioning installations. Figs. 5 and 6 present these same data in the form of average operating hours per month.

Since these units are not equipped with modulating controls, it is possible to determine operating hours by dividing the volume of gas consumed during the period in question by the rate at which gas is consumed by the unit when it is operating, expressed in terms of cfh. This rate is 72 cfh for the three-ton and 112 cfh for the five-ton, according to the manufacturer.

Figs. 5 and 6 offer average operating hours per month plotted against DDE's experienced during the month. It is noted that the three-ton units operated slightly more than the five-ton units.

The data presented in Figs. 5 and 6 should have general application to any central residential air conditioning unit operated in the Dallas area, and probably should apply generally to all such units in the United States. The DDE records may be obtained from the Weather Bureau for each local area. This method of correlation appears to permit realistic estimates of energy consumption. Average energy consumption for the specific unit in question may be obtained simply by multiplying the operating hours per month coinciding to the number of DDE's experienced during that month by the hourly energy requirements of the unit in question.

Figs. 3 and 4 indicate a straight line relationship between energy requirements and DDE's. Similar relationships between heating requirements and DDE's would generally exclude the effect of change of efficiency of the conditioning apparatus with change in atmospheric temperatures. The efficiency of the conventional space heating equipment, but not that of the heat pump, is substantially constant throughout the entire range of outdoor temperatures that are experienced. Conversely, the efficiency of the space cooling equipment generally decreases to some degree as atmospheric temperatures increase. The present analysis of data indicates that average change in efficiency of space cooling equipment is too small to be apparent in this type of investigation.

A study of Weather Bureau records indicates that 2750 DDE's have been experienced in Dallas as the average during the past ten years. According to Figs. 5 and 6, the three-ton units should operate about 2021 hr during an average year, and the five-ton unit about 1909 hr. Gas consumed by each three-ton unit during the average summer should be 146 Mcf, and gas consumed by each five-ton unit should be 214 Mcf.

Degree Day Excess, defined as the excess of the mean atmospheric dry bulb temperature above 65 F, appears to be directly proportional to gas consumed by central residential air conditioning units in Dallas.

Fig. 5 Operating hours for residential air conditioning; average of 130 three-ton units

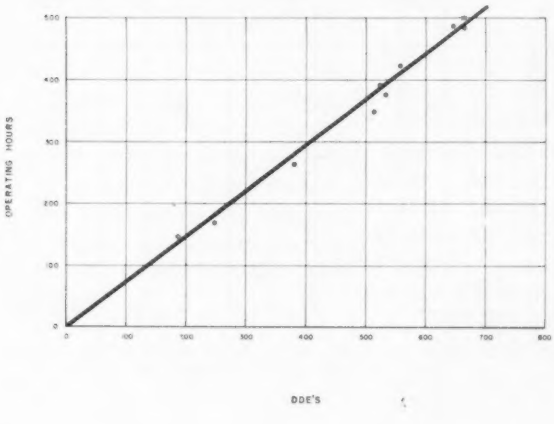
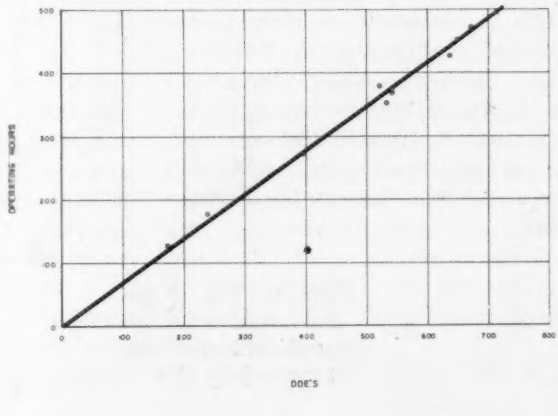
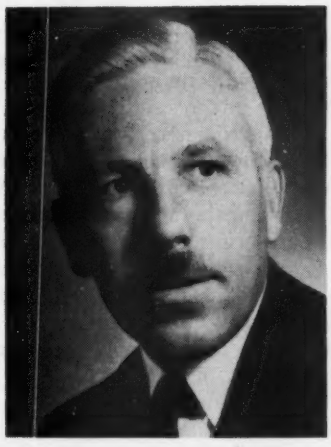


Fig. 6 Operating hours for residential air conditioning; average of 330 five-ton units



ASHRAE Financing

—how it works



JOHN H. FOX
ASHRAE
Second Treasurer

How does any organization, association, or society function without finances? The answer is self-evident. It does not.

The President's page this month is given to a discussion of the methods developed for the financial operation of ASHRAE.

We are members of a society, large in numbers. We are members, too, of a non-profit organization. The Society has a genuine purpose to assist in the development of the technical competence and social well-being of its members, and, no less important, the advancement of the arts and sciences of heating, refrigerating and air conditioning to the benefit of the general public.

Admission fees and annual dues must be sufficiently adequate to provide as many administrative functions as possible, yet low enough to permit participation of as many qualified persons as possible, within the membership structure. In our Society many of the services and privileges provided to the members cannot be provided from fees and dues alone. The dues must be supplemented. It is a "neat" problem.

Once the thesis is accepted that larger numbers of members – paying low or insufficient rates of dues – is the desired approach, then it is obvious that alternative or supplementary finances must be found to provide services such as technical publications (GUIDE, DATA BOOKS, JOURNAL); basic research program (Cleveland facilities and cooperative program with universities); and also Annual and Semiannual meetings; all to permit the free exchange of information in regard to engineering developments and progress within the associated and specialized fields of heating, refrigerating and air conditioning.

It would seem appropriate to discuss some of the financial functions as they apply to our Society. It is a certainty that many of our members are not too aware from where funds are secured nor how they are expended.

The most obvious source of income is from fees and dues. Admission fees are deposited in the General Reserve Fund. The purpose of such Reserves is described later in this article. Annual dues, on the other hand, are intended to cover all, or in part, two basic costs: first, the basic cost of administering a membership society, and second, to provide a large contribution to research activities. In the present budget schedule these provide only one of the principal sources of income and represent what might be termed "a first step" and, as such, are approximately 30% of the total income required for the operation of our Society.

Dues, therefore, make no provision for the financing of the publication of the GUIDE, DATA BOOKS, ASHRAE JOURNAL, Transactions and technical papers. All of these projects are very costly and could not be provided were it not that additional income, over and above the costs of publication, results from the sale of advertising space in the GUIDE and the JOURNAL. Income from publications results in about 45% of the total income.

The balance of the funds needed is secured from miscellaneous sources, such as: interest on invested reserves, contributions by industry to research activities, contracts for research projects, etc., and last, but far from least, income from the bi-annual expositions. The last named funds represent a portion of the Exposition space rental and are allocated specifically for research activities.

So far we have discussed only the sources of income. In an article of this nature, it should likewise be appropriate to also discuss expenditures.

The operation of any society requires the full time services of an adequate, well-trained and capable staff. Our Society is no exception in this regard, but we are fortunate in the people, who, under the direction of the Executive Secretary, are administering our Society affairs. The direct expenses at headquarters, which include salaries and staff costs, rental and building services, furniture and equipment, plus services and supplies, absorb about one-third of the total income.

The next largest group of expenditures of the Society are those concerned with the operation of the Research Laboratory at Cleveland, and cooperative research projects with other research institutions or groups. Over the years, our Society has always spent about 25% or more of its income in basic research activities.

Publications require a provision of approximately one-third of the total income. These expenditures provide for the preparation of editorial material, printing, binding and mailing of our publications. To repeat – under publications are such items as the GUIDE, DATA BOOKS, ASHRAE JOURNAL, Transactions, Membership Roll, reprints of papers and technical summaries–all as authorized and required by the Publications Committee.

The remaining small proportion of funds is required for expenses incidental to Annual and Semiannual meetings, authorized expenses of senior officers, authorized committee expenses, and for assistance and development of chapter activities.

Should there happen to be a

small operating surplus, such is placed in the General Reserves of the Society.

Reference has been made to reserves. It is well recognized that a continuing society such as ours should have some form of reserves. Our Society has two principal reserve accounts, one termed General Reserves, the other Research Reserves, and other lesser accounts for honors and awards.

The purpose of the General Reserve accounts is to provide insurance of stability and to prevent wide fluctuations in Society activities, which could well be influenced by outside economic conditions. It is well known that depressed economics or business conditions directly and quickly depress Society income. Likewise, buoyant conditions improve Society income.

These reserves are NOT subject to impulsive action and their use is rigidly controlled so that such funds are only available in cases of genuine and specifically detailed need.

The reserves and invested funds of the Society are administered under the advice of recognized investment counsel – people who have a broad knowledge and outstanding record in handling trust funds.

Present thinking is that General Reserves should not be in excess of approximately the amount required for one year of operation. Research Reserve accounts, on the other hand, are the depository for funds earmarked for research–either from contributions of industry or from dues allocation.

Costs of the merger of the two original societies into ASHRAE, while not excessive, have required the use of some of the General Reserves.

The Society endeavors to operate on a balanced budget and therefore close attention to the flow of income and expenditures is the paramount duty of the Finance Committee, which reports and recommends to the Directors on matters dealing with Society finance. The results of this attention are most apparent in the extent of services provided to the membership at the relatively low rate of dues paid by each member.

In conclusion, very frequently problems of finance for a society such as ours are shunned except by a small number within the membership, who find the problems intriguing and of prime interest or concern. The writer is one who recognizes the need for finance and is aware of the need for at least a passing knowledge of where funds come from, how they are spent, and also the need to ensure that there shall be sufficient reserves, etc., to provide uninterrupted operation of our projects and services. The whole of any financial program should be consistent with the growing need to keep pace with the expanding knowledge of the arts and sciences of our engineering specialty in the interests of an ever-growing membership and the general public.

It is our hope that this article on finances, written by one who is not an accountant, has somewhat enlightened other non-accountant members, who are aware that finances are essential to ASHRAE.

What future for solar heating?

Engineering solutions to problems allied with the possible uses of solar energy require heavy expenditures for equipment, so that the cost of solar heating lies largely in the amortization and upkeep of the system. Architectural concessions must be made; it is only recently that the public has given limited acceptance to architectural designs which would permit the incorporation of the large solar collector surfaces.

Despite the marginal economy of solar space heating at the present time, the future is relatively bright. One has but to review the trends of the costs of fossil fuels during the past several decades as well as the extent of our stored energy reserves to conclude that in all probability the costs of oil and gas will continue to rise, particularly in relation to the cost of electricity. Parallel with this, the cost of solar collection and storage equipment is continually lowering.

In the future, the greatest competitor to solar heating may be electric heating. High voltage long distance electric transmission systems will make more feasible the use of extensive solid fuel deposits, and nuclear fuels may be used for electric power generation without the intermediary of steam generation. If this proves to be true, electricity may well be the dominant source of energy for space heating. However, increasing standards of living may require that space heating be coupled with space cooling. Barring the development of economic, large scale thermoelectric cooling, this may best be accomplished with vapor compression or absorption heat pump systems. At the same time, the use of solar energy as a total or partial heat source for the heat pump will make heat pumps more feasible to operate, particularly in northern climates.

SOLAR ENERGY AVAILABILITY

One of the most serious inherent limitations in the utilization of solar energy for engineering purposes is the intermittent nature of the energy source. The variations are not only geographical, diurnal and seasonal in a predictable way, but the energy also varies with

This is a condensed version of "The Future of Solar Heating" as presented at the Fall Conferences of the Building Research Institute in Washington, D. C., November 17-19. Dr. R. C. Jordan is Head of the Department of Mechanical Engineering, University of Minnesota. He is Chairman of the ASHRAE Research and Technical Committee.

cloud cover in a manner which can be anticipated only statistically. Even with no cloud cover the direct solar beam in passing through the atmosphere is reduced by the mass of the atmosphere, by Rayleigh scattering, by water vapor scattering, by dust particle scattering, and by ozone absorption.

The attenuation of the direct solar radiation beam is predictable insofar as the air mass through which it must pass is concerned. However, the attenuation with dust particle concentration in the atmosphere and with the amount of precipitable water vapor contained in the atmosphere is not nearly as easy to estimate; yet both factors are important. The dust concentration in the atmosphere may range from a dust index of 200 particles per cc with a rather clean atmosphere to 800 particles per cc in an essentially industrial one. A typical variation of precipitable water in a basic atmosphere will range from 0.3 in. in the winter months to 1.2 in. in the summer months. The precipitable water vapor contained in the atmospheres along the Gulf of Mexico and in Florida are quite high and this attenuates the radiation available. The precipitable water vapor found in the Rocky Mountain area or in the northern part of the Midwest is comparatively low, and this in turn increases markedly the available radiation. It is these factors which make the prediction of the solar energy source so complicated and the use of a heat storage media for use between the periods of reasonable solar availability so necessary.

Optimum orientation of a solar collecting surface would be one which was continually so changed as to be perpendicular always to the sun's rays. Mechanical and architectural considerations make this impractical for space heating, although a stationary vertical surface or a tilted surface usually can be incorporated into the design. The only observatory in the United States which has made measurements of a comparatively continuous nature of the solar radiation available on a vertical surface is that located at Blue Hill, Mass.

It is difficult at this point in our knowledge to make a completely meaningful estimate of the zones of minimum, moderate, and maximum feasibility for the utilization of solar radiation for space heating.

SOLAR COLLECTORS

Once the degree of solar energy availability and predictability has been determined, solar energy collectors must be designed to permit the energy collection and storage for heating purposes. If the energy so collected is to be used at high temperature for such purposes as solar furnaces and cookers, or for distillation or drying, concentrating devices shaped as paraboloids or parabolic troughs with a collecting element located at the focus may be used. Concentrating collectors permit the attaining of high temperatures but they also have high thermal losses, and since they must be continually focused, they are inherently difficult to adapt to space heating. Further, their capital costs are high, and there is no thermodynamic advantage in collecting solar energy at high temperatures for ultimate use at the moderate temperatures required for space heating.

A much cheaper and more satisfactory solution is the use of flat plate solar collectors with a fixed orientation to take maximum advantage of the available solar flux at a time when the heating demands are likely to be greatest.

Flat plate collectors inherently are simple devices for both the collection of solar energy and heat exchange to a working medium such as air or water. These devices consist basically of blackened surfaces which will permit a high absorption of the impinging solar radiation, glass or plastics bounding surfaces on the side facing the solar flux, and some type of insulated container to reduce losses from the collector assembly. The glass or plastics should be highly transparent to the incoming solar radiation but comparatively opaque to the low temperature reradiation from the absorber plates so that the collector may act as a heat trap. If the heat exchange fluid is water, it is usually circulated through tubing attached to or incorporated into the plate assembly. If air is the collecting medium, it must pass through an area directly adjacent to the collector surfaces.

R. C. JORDAN

The amount of solar energy which can be collected by such a device varies with the location but also increases as the collection temperature decreases. Actual experimental collectors using a collection temperature of 100 F and located at various points have shown average winter solar energy collection ranging between about 10,000 to 15,000 Btu/sq ft/month.

Presently, solar flat plate collectors used for space heating cost approximately $2 to $3 per sq ft.

Within most of the United States, solar space heating is feasible technically but economically marginal. Though it may seem that the use of solar energy for space heating should be both cheap and simple, since the quantities of energy available are vast and widespread, this energy, so free for the taking, is expensive to collect and to store. The total solar energy striking the land area of the United States is in the order of 313,000 kw hr per person per day, and the amount striking the roof of an ordinary house in the southern part of the country averages roughly two million Btu per day.

It is so diffusely spread that large collection areas must be involved, and it is so variably available that for space heating it must be stored and supplied upon demand.

Such collectors incorporate two or three glass or plastics cover surfaces transparent to solar radiation. The total weight averages two to six lb/sq ft. To a great extent the economic utilization of solar radiation for space heating is dependent upon reducing these costs and increasing the efficiencies of collection. It seems probable that eventually the cost can be reduced to approximately $1 per sq ft or less. However, it must be recognized that the amortization of the original capital cost is not the only cost involved. Pumping costs for circulation of the collecting fluid must also be given consideration, and maintenance costs must also be included. This latter cost is one which has not been given effective evaluation since the numbers of solar heated houses are still too infrequent to permit sufficient maintenance experience.

There are several areas of research and design activity associated with solar collectors which may lead to an increased quantity of heat collected per dollar cost of collector. First, the cost of the collector itself may be reduced by mass production and by the use of materials which will reduce the fabricating cost. For example, plastics materials transparent to solar radiation may be developed which are cheaper than glass and have quite as satisfactory high solar radiation transmission characteristics and low temperature reradiation characteristics. Copper and aluminum flat plate absorbing surfaces have been developed which include heat exchange tubing available in different configurations as an integral part of the plate and this eliminates the costly independent fabrication of plates and tubes and the bonding of the two.

The second factor involved in increasing the heat absorption per unit cost of collector surface is the efficiency of the collector itself. Here, three major possibilities for improvement exist. The first of these concerns the development of stable surface treatments which can be applied to glass or to other solar transparent bounding surfaces in order to reduce the amount of energy reflected at high angles of solar incidence. The second concerns the use of selective collector surfaces which will have a high absorptivity for short wave length solar radiation but a low emissivity for the low temperature, long wave length, energy reradiated from the collector plate. One development in this area reports surfaces with 90% absorptivity for solar radiation and emissivities of 10% for the reradiated energy.

The third possibility concerns the use of secondary reflector surfaces in conjunction with flat plate collectors. Surfaces designed to make use of the ground area in front of a vertical collector or secondary vertical baffles rotated to make use of adjacent space can increase the available radiation by as much as 10 to 50%.

TABLE I—HEAT STORAGE CAPACITY OF VARIOUS WORKING MEDIA

Material	Sensible Heat, Btu/cu ft —20F temp. rise	Latent Heat, Btu/cu ft.	Melting Point, F
Water	1248	——	——
Iron	1078	——	——
Concrete	756	——	——
Brick	480	——	——
Gravel	400	——	——
Nitrogen pentoxide	——	14,000	85
Gallium	——	12,700	86
Sodium phosphate dodecahydrate	——	11,400	94
Sodium sulfate decahydrate	——	9,400	90
Water	——	9,000	32
Nickel nitrate	——	8,400	132
Calcium chloride	——	7,700	86
Osmium tetroxide	——	7,500	104
Zinc nitrate	——	7,200	98
Calcium nitrate	——	6,900	108

SOLAR ENERGY STORAGE

Since the solar energy source is highly variable it is mandatory that any solar space heating be designed with either an energy storage system, auxiliary heat, or both. Studies indicate that it is generally uneconomical to plan thermal storage for the most rigid design conditions which may be encountered and that it is preferable to use such storage to supply heat during the majority of those periods when solar energy is not available, but to use auxiliary heat as an emergency measure during the relatively few cloudy periods of long duration. The balance between thermal storage and auxiliary heat is determined from economic considerations.

The only systems of energy storage yet attempted in solar space heating applications involve either sensible heat or latent heat thermal storage. A comparison of the amount of heat which can be stored per cu ft of space, either by a 20 F temperature rise of cheap and abundantly available materials such as water, gravel and concrete or by the change of phase of a material such as sodium phosphate dodecahydrate is presented in Table I. If solar space heating is to be carried out directly from the storage system, the heat should be stored at a temperature somewhat higher than that demanded in the heated space. In such cases, storage is usually carried out at temperatures between 90 and 150 F. If a heat pump is to be used as an intermediary between the storage system and the actual supply of heat to the house, then the purpose of storage is to increase the coefficient of performance of the heat pump and storage is usually conducted at temperatures of 35 and 55 F and the temperature level of the energy is raised by use of the heat pump.

To date, practically all of the solar space heating systems constructed have used as heat storage media either water, rock and gravel or sodium phosphate dodecahydrate. Examination of Table I reveals definite storage capacity advantages in using materials which change phase and release or absorb heat in so doing. Water and rock, however, have the advantage of abundant availability and extremely low cost. Furthermore, a system using water for heat storage, also has a "built in" auxiliary heating system when used in conjunction with a heat pump. If the energy

demands are sufficiently great so as to reduce the water temperature close to freezing, city water may be added and in this way the storage water temperature is increased.

The thermal advantages of using change of phase storage materials are readily evident. The disadvantages are higher cost and instability. Most salts which can be considered for this purpose undercool to a marked extent and therefore require a nucleating agent to aid crystallization. Many of the materials are not completely reversible for an indefinite period of cycling time. Additional research is needed in the development of improved change-of-phase storage media.

In addition to solar energy storage by direct heat storage, there are many other systems which demand eventual investigation and possible consideration. Direct conversion of solar to electrical energy and the storage of the electrical energy in batteries is one possible development. Other possibilities include the translation of solar energy by inertial energy, by the compression of gases, by chemical reactions or by the growth of biological materials which can be retranslated back to heat energy. The possibilities of storing solar energy in a closed cycle fuel cell with regeneration of the fuel or direct generation of the fuel through solar radiation are almost completely unexplored.

ARCHITECTURAL CONSIDERATIONS

The mass adaptation of flat-plate collectors for solar heating to residential construction would not be feasible for typical houses on typical city lots at the present time. The typical lot pattern of many cities providing 40 to 60 ft lot width with perhaps a 100 to 125 ft depth with setbacks and side yard clearances as well as lot orientations such as east and west would not permit the satisfactory incorporation of solar collectors to the majority of the house designs now being constructed. Height control of houses and the surrounding obstructions would be necessary, and houses should be south oriented in such a way as to make maximum use of solar availability throughout the winter.

Technically feasible; economically marginal

Energy striking the roof of an ordinary house in the southern part of the United States averages 2 million Btu per day

Energy source is highly intermittent

Orientation of a solar collecting system must be changed continually

It is mandatory to provide either an energy storage system, auxiliary heat, or both

It is reasonable to expect . . . solar heating systems will be at least competitive with conventional ones

The typical detached single family house now predominant in urban areas neither lends itself aesthetically nor functionally to the proper adaptation of solar collectors.

However, the problems are far from insurmountable and urban areas laid out properly with control over lot sizes, orientations and the height of houses and surrounding obstructions would permit the mass use of solar collectors. Probably in most cases a courtyard type of house with the collectors located in the courtyard area would provide the best solution.

SOLAR HEATING SYSTEMS

The principal components of any solar heating system consist of the solar collector, a heat storage facility, a heat distribution system, a transport system, and in some cases an auxiliary fuel and heating system. In some instances the addition of a heat pump and perhaps an additional low temperature energy source are used. The solar energy, after collection, either passes directly to the heat sink or heating demand, to storage or to a heat pump. If the energy goes to storage, it may pass from there to the heat pump or directly to the demand. Because of the variability of the solar source, auxiliary fuel may be needed, and this may be applied directly to the demand, directly to storage, or to the heat pump. Further, an additional low temperature energy source may be necessary for proper operation of the heat pump, and this may be any of the available media such as water, air, or the earth.

These various components may be applied in a variety of combinations thus permitting a wide latitude of choice to the designer. In general, if the energy is to be collected and stored at a temperature higher than room temperature, then the energy may flow directly to the demand or be stored for subsequent use. However, if the energy is to be collected at a temperature lower than 70 F, the system must utilize a heat pump to raise the temperature level, and then reject the heat either to the demand or to storage.

The use of a heat pump increases considerably the amount of equipment needed for the entire system, but it does reduce greatly the amount of collector surface needed and often the amount of storage capacity required. The integration of solar energy into the heat pump system as a means of providing heat at a temperature of approximately 40 to 50 F greatly increases the efficiency of the system and permits its wider application in more northerly climates where rigid winters are experienced. Further, the heat pump may be reversed in application during the summer months so as to provide a complete heating and cooling system.

Results obtained with several solar space heating systems have been too limited to permit broad conclusions but there is ample reason to expect that with mass production of components and with further technical developments reasonable to expect, solar space heating systems will be at least competitive with conventional systems.

Members of ASHRAE participate in

BRI heating conference

Highly definitive, the six-speaker Building Heating Conference which accompanied the fall program of the Building Research Institute in Washington, D. C., November 17-19, was under the chairmanship of John Everetts, Jr., Fourth Vice President of ASHRAE. Step-by-step, successive speakers traced the fundamentals of heating engineering in comprehensive presentations devised to review individual topics authoritatively for the record.

Energy and fuels, in a paper prepared by W. F. Friend and A. L. Jordan of Ebasco Services (presented by the latter) touched upon virtually every energy source which might be applied to heating techniques. The authors contended that conservation measures should be devised before long and implemented on a broad front. However, currently fuel producers are actually beset with troubles from surplus and planning for controlling over-production and imports to leave an interval during which rising consumption shall overtake excess production capacity and restore the balance between supply and demand. Essentially, the solid fossil fuels were evaluated for reserves far in excess of their oil or gas counterparts. Full consideration was given to nuclear, solar, fuel cell, thermoelectric convertors and the more exotic side shows of geothermal energy, gravitational potentials, tidal power and wind energy. In summarizing, the authors concluded that conventional energy sources should continue to be available, at least through 1975, at no appreciably higher constant dollar cost.

To H. T. Gilkey, Director of Technical Services, National Warm Air Heating and Air Conditioning Association, fell the topic of new air heating methods. Author Gilkey assured "the heating industry is on the verge of major breakthroughs which will result in totally new designs using new materials and technology." Specifically, it was anticipated that future heat exchangers could be made a great deal smaller and much could be accomplished in the methods of catalytic combustion using gaseous fuels. Thermionic conversion, despite the many problems to be overcome in developing any practical thermionic convertors, received his consideration. Concluded the speaker, "we must remember that the heating system is unlike any other component which goes into a residence. It is literally manufactured on the job. The furnace, controls, supply outlets, ducts and all other such things are solely components. None is a finished product. This means that in order to evaluate the performance which can be expected from a heating system we must take a look at the man who designs, installs and adjusts it for he is the all-important factor. The big change, the big forward step in heating, is an increasing awareness of the system by the homeowner, the builder, the heating and air conditioning contractor and the manufacturer. Without this awareness no other progress will be possible either now or in the future."

Hydronic systems were the topic of the late H. A. Lockhart, Vice President and Chief Engineer of the Bell and Gossett Company, who chose to emphasize the relatively new primary and secondary pumping method used to improve zone control of heated and cooled areas. The principle, essentially that of creating a tandem-parallel pattern for fluid flows, results in the permissible use of smaller pumps, of reduced horsepower requirements, of smaller and less costly accessories and provides a high degree of flexibility.

Professor J. R. Carroll of the Dept of Mechanical Engineering, University of Illinois, became the exponent of radiant systems for heating and within his discussion reviewed those electrically energized and gas-fired, as well as high and low temperature water and steam facilities available for this purpose and as to future innovations. Professor Carroll looked forward to such things as electric drapes (based upon the electric blanket or sheet type of design) which might be used to reduce heat losses through windows and even to electric windows which might be formed of conductive glass to supply warmth to the occupied area.

Confining his observations to projections of the uses of electricity in heating, Market Research Manager F. H. Faust of the General Electric Company developed a discussion based upon those points where electric heat may best be applied, the economics of its use and future possibilities. He pointed out that 83% of current sales of heat pumps were within a relatively small and climate-favored section of the United States but that progress in engineering and changes in the relation of the cost of electricity to that of fuels provides a factor for constructive engineering and that technical advances would change this situation also.

The future of solar heating systems was approached both from the theoretical viewpoint and the aspect of practical, experience-acquired knowledge by Dr. R. C. Jordan, Head of the Dept of Mechanical Engineering, University of Minnesota, and Past President

of precedent ASRE. The speaker, currently chairman of the Research and Technical Committee of ASHRAE, conceded such developments to be technically feasible but economically marginal. Solar Btu's are free for the taking but expensive to gather and store. Energy received from the sun, through the atmosphere, becomes a variable and thin source of energy and power at the earth's surface. Heavy expenditures for equipment link with a perhaps undue restriction upon the design of a heated structure and similar considerations complicate the problem. Citing experience at several points in this country and in Japan, Dr. Jordan concluded that the potentialities might best relate to hoped-for outcomes when they linked the use of solar energy with the application of carefully planned and designed heat pump installations.

WHAT IS NEEDED

Following the formal presentations of the six speakers, all of whom are members of ASHRAE with the exception of A. L. Jordan, the Chairman encouraged questions from the floor which might serve to develop the discussion further. This led to subsequent comments by the programmed speakers, each of whom undertook to express his own feelings as to what future heat research should attempt.

Thus, Director of Technical Services Gilkey, in urging more research, recommended new types of air moving devices and higher static pressures unaccompanied by relatively high noise levels and better means of communication between contractors, owners and architects.

Chief Engineer Lockhart emphasized that in putting parts together for good functioning as a whole much better statistical information is needed regarding components and their performance levels.

Market Research Manager Faust agreed as to the need for better information, conspicuously in regard to true measures of individual comfort. He stated that more should be known about losses of radiant heat to cold surfaces as affecting comfort, that ways should be devised to better fit heat pumps to desirable utility company load characteristics and that the problem of the designed C.O.P. to which a machine is developed might well be given constructive study. Thermoelectric progress, reminded the speaker, needs emphasis upon the development of better materials.

Dr. Jordan conceded that with better knowledge and improvements in surface materials, energy collectors, absorber plates and similar functional components solar systems might within 10 years progress to where the heat pump is today. He emphasized what is sought is essentially a heat trap of optimal specifications but that radical methods of storage might result from today's research and that less complicated controls for automatic operation could be anticipated.

Professor Carroll referred to the possibilities of electrically conductive films upon walls and ceiling as means of supplying heat and asked that the safety considerations allied with the use of high temperature water in places of public occupancy be studied.

There were other conferences, too, and these included sandwich panel criteria as related to new heating techniques, modular coordination and metal curtain walls. Thus, other speakers provided reports upon building research and progress in Canada, in the Netherlands, South Africa and Japan. Case studies of selected buildings using metal curtain walls were cited and there were proposals for new building research to further project the more skillful handling of material and principles.

E. R. Queer, Director, Engineering Experiment Dept, Pennsylvania State University, and Past President of precedent ASHAE, had the topic of heat transfer and moisture transmission.

HEAT PUMP AIR CONDITIONS HONG KONG BUILDING

Used in the installation of a 310-ton water-to-water heat pump in the North Kowloon (Hong Kong) Magistracy Building will be ammonia compressors converted for Refrigerant 22 service. Offered through Yee On Hong Company, Ltd., Worthington Corporation's distributor, were two VSA 10 by 10 in. ammonia compressors, specially treated and equipped with a mechanical shaft seal to meet the requirements of slow speed, spring-loaded safety heads and Refrigerant 22 service.

Each of these compressors will produce 155 ton at a speed of 450 rpm when driven by a 200 hp motor and will operate in parallel. Sea water from Hong Kong Bay will be used to cool the condensers. Changeover from summer to winter operation will be done by manually reversing the refrigerant flows.

During summer cycle each of the direct expansion chillers will cool 465 gpm from 50 to 42 F. As the condenser during the winter cycle will operate as a flooded chiller, a 20 in. by 8 ft receiver is incorporated in the system to provide adequate storage for the refrigerant. A suction trap will protect the compressors from liquid carry-over.

AUTOMATIC SNOW REMOVAL

Installed in two concrete sidewalks bordering the Columbus and Southern Ohio Electric Company's ten story office building in Columbus, Ohio, is an automatic snow removal system. Completely imbedded in 5½-in. thick structural slabs are Byers 4D wrought iron pipe grids spaced on 12-in. centers. Designed by Ebasco Services, Inc., the system can be operated either automatically or manually. At a rate of 350 gpm, lightweight heat transfer oil at 95 F is circulated through the pipe, melting snow as it touches the sidewalk. Used for both heating and cooling operations, a 650-ton air-to-air heat pump provides part of its output to the snow melting procedure.

ASHRAE Financial Statements

To the Board of Directors

American Society of Heating, Refrigerating
and Air-Conditioning Engineers, Inc.

In accordance with the authority contained in Article V, Sec. 5.14 of the By-Laws, we have examined the Consolidated Statement of Financial Condition of the AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS, INC., at June 30, 1959 and the related Statements of Income and Changes in Fund Balances for the five months then ended.

This five month period was the first consolidated fiscal period of the former American Society of Heating and Air-Conditioning Engineers, Inc., and The American Society of Refrigerating Engineers, Inc.—both of New York—which were consolidated under the laws of the State of New York on January 29, 1959. This consolidation was approved by the memberships of the constituent societies.

Our examination was conducted in accordance with generally accepted auditing standards, and accordingly included such tests of the accounting records and such other auditing procedures as we considered necessary in the circumstances; except that we did not confirm dues and accounts receivable by direct communication with members and debtors.

We are pleased to present our report of this examination. In our opinion, these financial statements present fairly the financial condition of the American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., New York, at June 30, 1959 and the results of its operations for the five months then ended, in conformity with generally accepted accounting principles and the directives of the governing body of the Society.

Frank G. Tusa & Co.
Certified Public Accountants

New York, N. Y.
August 31, 1959

Consolidated Statement of Financial Condition—All Funds June 30, 1959

ASSETS		
Current		
Cash on Hand	$ 250.00	
Cash on Deposit		
Checking Accounts	$157,605.83	
Savings Accounts	239,611.66	
Investment Advisory Accounts	2,173.58	399,641.07
Dues and Accounts Receivable		
Membership Dues	67,712.84	
Less:		
Allowance for Doubtful Dues	22,712.84	45,000.00
Accounts Receivable	23,914.95	
Less:		
Allowance for Doubtful Accounts	1,178.18	
Allowance for Advertising Agency Commissions	1,343.32	21,393.45
Deposits and Accommodations		2,060.03
Accrued Interest Receivable		1,672.71
Inventories—at Lower than Cost or Market		45,572.48
Prepayments		
Fire and General Insurance	7,182.46	
Employees' Group Life Insurance	1,164.39	
Publications	3,260.61	$ 526,947.20
Investments at Cost (Market Value—$399,541.45)		358,547.61
Property and Equipment		
Land and Building	94,115.82	
Laboratory Equipment	27,450.31	
Furniture and Fixtures	23,430.94	
Tools	300.00	
Library	300.00	
Less: Accumulated Depreciation	20,615.54	124,981.53
		$1,010,476.34
LIABILITIES AND FUND BALANCE		
Current Liabilities		
Accounts Payable	$ 15,583.90	
Employees' Income Taxes Withheld	8,410.57	
Accrued Payroll Taxes	1,695.25	
Prepaid Candidates' Dues and Admissions	5,243.08	
Prepaid Elected Membership Dues	37,207.03	
Deferred Income		
Journal Subscriptions	281.26	
Membership Dues	166,552.97	
Earmarked Contributions	4,348.86	
Reserve for Fluctuation of Canadian Exchange	201.45	
		$ 239,524.37
Consolidated Fund Balance		770,951.97
		$1,010,476.34

Income and Expense—Society General Fund For the First Consolidated Fiscal Period January 29, 1959 through June 30, 1959

INCOME		
From		
Membership Dues	$152,228.71	
Admission Fees	6,244.00	
Exposition Balance	3,188.76	
Emblems	385.35	
Publications		
ASHRAE Journal	$ 81,324.28	
Data Book	12,412.56	
Guide	174,409.73	
Transactions	622.40	
Standards, Reprints, Charts, etc.	5,549.99	$ 436,365.78
EXPENSE		
Direction and Guidance Travel		
Board of Directors	3,708.54	
Committees		
Officers and Executive	2,367.23	
Chapter Regional	6,423.21	
Regional General	2,304.96	
Finance	11.39	
Long Range Planning	280.94	
Admissions and Advancement	247.30	
International Relations	135.88	
Program	229.03	
Publications	120.09	
Standards	327.97	
Public Relations	192.00	$ 16,348.54
Chapter Supplies and Allowances		9,642.15
Certificates		104.05
Emblems		668.36
Medals and Awards		24.91
Dues—E. J. C.		2,981.00
Memory Books		333.18
Consolidation—Moving, Printing, Mailing, etc.		1,822.10
Meetings		
Host Chapter Allowances	800.00	
Annual Meeting	10,035.70	10,835.70
Total Direction and Guidance Expense		42,759.99
Income available for Publications and Administration		393,605.79
Publications		
ASHRAE Journal	67,949.35	
Data Book	9,818.82	
Guide	136,873.76	
Transactions	201.01	
Standards, Reprints, Charts, etc.	3,805.02	218,647.96

Administration		
Salaries		127,014.79
Payroll Taxes		3,501.38
Public Relations		2,264.61
Secretary and Staff Travel		5,518.85
Rent and Electric		10,323.45
Telephone		2,610.26
Telegraph		274.04
Postage		4,982.36
Printing and Stationery		8,773.19
Membership Tabulations		2,051.04
Professional Services		1,925.00
Bank Charges		13.54
Insurance		735.26
General Office Expenses		3,117.74
Pension, Group Life Insurance and Service Fee		3,097.39
Depreciation—Furniture and Fixtures		1,006.59
Provision for Doubtful Dues		15,166.16
		192,375.65
Total Publications and Administrative Expense		411,023.61
Excess of Expense over Income		17,417.82
Less: Financial Income		
Distribution from Investments Account	2,737.17	
Interest on Savings Deposits	648.55	
Interest on Short-Term Notes	53.38	
Foreign Exchange Conversion	376.98	
Total Financial Income		3,816.08
Excess of Expense Charged to Fund Balance		$ 13,601.74

BULLETINS

Recirculated Gas. Defined as the method by which gas from the boiler, economizer or air heater outlet is reintroduced to the furnace using a suitable fan and ducts to obtain proper proportioning of heat within a steam generator, recirculated gas and its relation to boiler design and operation is the subject of 20-page Bulletin G-96.
Babcock & Wilcox Company, Boiler Div, Barberton, Ohio.

Motion-Control Sheaves. Descriptive of the MCS variable-speed sheaves with resilient cam-follower design cited as eliminating freezing and sticking is 8-page Bulletin 8102. Construction is shown by cutaway illustrations and diagrams. Tables facilitate the selection of companion sheaves and belts to meet specified drive requirements. "Sure-Grip" companion sheaves, variable-speed belts and motion-control motor bases are also covered.
T. B. Wood's Sons Company, Chambersburg, Pa.

Control of Dynamic Environments. Modern advance in the fields of shock, vibration and noise have made evident the need for specialized engineering in order to obtain adequate solution to many problems. Describing the capabilities of this organization in that area is 12-page Bulletin 59-06.
Barry Controls, Inc., P. O. Box 215, 700 Pleasant St., Watertown 72, Mass.

Snap-Acting Thermal Elements. "Story of the Spencer Disk" is a 29-page bulletin describing the origin and operation of the snap-acting disc-type thermal element. Detailed is the way in which this disc actuates Klixon thermostats, circuit breakers and inherent overheat motor protectors. Also outlined are other, non-disc-actuated controls, such as motor starting relays, precision switches and thermal valves.
Texas Instruments, Inc., Metals & Controls Div, 34 Forest St., Attleboro, Mass.

Copper and Brass Tubular Products. Listed in the 16 pages of this catalog is the complete line of water tube and pipe; drainage, commercial, refrigeration service, condenser, general purpose and automotive tube. In addition, tube specifications, applications, range of lengths and sizes are presented.
Wolverine Tube Div, Calumet & Hecla of Canada, Ltd., P. O. Box 758, London, Ontario, Can.

Spray Finishes. Providing an appearance comparable to coatings made by the use of bronze powder but offering advantages over these conventional finishes, Bronzeless Golds are lower in cost, non-tarnishing, non-gelling, harder and easier to apply. Available in a full array of matched colors as well as a number of standard hues, the finishes are discussed in an eight-page booklet. Chips displaying the standard colors are shown.
Bee Chemical Company, Logo Div, 12933 S. Stony Island Ave., Chicago 33, Ill.

Draftless Air Systems. Conventional air diffusers, units for school systems, high induction air diffusers, high capacity dual duct units and an air meter for balancing and checking air systems are products described in four-page Bulletin 31f/An.
Anemostat Corporation of America, 10 E. 39th St., New York 16, N. Y.

Extruded Aluminum. Latest information on aluminum alloys and the aluminum extrusion process are included in 12-page Bulletin 5909. In addition to descriptions of available aluminum alloys, information on mechanical properties, recommended uses and reference numbers are given. The different basic extrusion types are illustrated and discussed, together with standard tolerance and pricing factors.
Precision Extrusions, Inc., 720 E. Green Ave., Bensenville, Ill.

Safety Cleaning Solvents. Offering of substantial savings in material costs to industrial users is claimed for the series of cleaning solvents described in this flyer. Eleven standard formulations ranging from wash-up solvents to high safety factor blends for hazardous locations are available. Listed in the bulletin are applications, safety factors, flash points and relative drying time.
Harco Chemical Company, Cranford, New Jersey.

Gas-Fired Furnaces. Adaptable for year-round air conditioning, models in this line, dimensions and specifications for which are given in eight-page Bulletin 179, can be installed in basement, utility room or closet. Gas manifold, burners, controls and draft diverters are concealed completely in these compact units, to be brought into reach by removal of the front cabinet panels.
Henry Furnace Company, Medina, Ohio.

Surface-Mount Temperature Controls. Descriptive of the Series 30000 controls is Flyer MC-186, giving complete specifications for the series and providing details on 11 different modifications to them. Three types of instrument are discussed: two for the general 50 to 300 F range and one for 50 to 600 F. All units are adjustable.
Fenwal Inc., Pleasant St., Ashland, Mass.

Plans outlined for revised grouping of ASHRAE Technical Committees

R. C. JORDAN
Chairman ASHRAE
Research and Technical Committee

The Research and Technical Committee of the ASHRAE was formed from a merging of the activities of the former ASHAE Research Committee and its Technical Advisory Committees with the ASRE Research Committee and the ASRE Technical Committees. This activity is among the most important functions of our Society and the development of an operational structure which will allow the best possible pattern for the future technical and research growth of the Society has proven both an opportunity and a challenge. An analysis of the problems which faced the Research and Technical Committee in consummating this merging was outlined on the Research Page of the May 1959 issue of the ASHRAE JOURNAL.

The new pattern of operation discussed in part in the May issue has been approved by the Board of Directors and a definitive structure for the continuing Research and Technical Committee activity is now being implemented. It is the purpose of this page to outline in some detail this new structure. A general organization chart of the Research and Technical Committee is shown in the accompanying diagram. Fundamentally, the Research and Technical Committee has two divisions, the Technical Division and the Research Division. Under the Technical Division there are now being formed eight technical groups designated as follows:

- Technical Group 1.0—Basic Theory and Materials
- Technical Group 2.0—Basic Equipment
- Technical Group 3.0—Auxiliary Equipment
- Technical Group 4.0—Systems
- Technical Group 5.0—Heating and Refrigeration Loads
- Technical Group 6.0—Environmental Control and Effects
- Technical Group 7.0—Unitary Equipment
- Technical Group 8.0—Products and Processes

Under each of these Technical Groups a series of Technical Committees is being formed following in pattern the earlier structure of the Technical Committees of ASRE. These Committees have been constituted from either (a) a former Technical Committee renumbered, (b) a former Research Advisory Committee renumbered as a Technical Committee or (c) the combination of a former Technical Committee and a former Research Advisory Committee or two former Technical Committees. In no case has a former Committee of either Society been eliminated but a number of them have been regrouped and renamed. All personnel active in the Research and Technical activities of either Society have been given continuing assignments.

In those cases where committees have been combined and regrouped former Chairmen of the component committees are being asked to serve as Co-Chairmen of the continuing committee. Each of the Coordinators of the former areas of Technical Committees has been invited to continue as Coordinators of one of the new groups. Letters of detailed explanation are now proceeding to all members, Chairmen, and Coordinators outlining their status in the new Committee structure.

The earlier Technical Advisory Committees have been eliminated and six new Research Advisory Committees formed. These have been defined functionally and are designated as follows:

- Research Advisory Committee 1.0—Energy Transfer
- Research Advisory Committee 2.0—Mass Transfer
- Research Advisory Committee 3.0—Energy Conversion
- Research Advisory Committee 4.0—Environment
- Research Advisory Committee 5.0—Materials
- Research Advisory Committee 6.0—System Analysis

These Committees are new and the personnel of the Committees are now being selected. In addition, Research Panels are being formed to operate under these Committees. These Research Panels are to be given specific tasks and once these tasks have been completed the Panel will be discharged. The Research Panels now in the process of formation are:

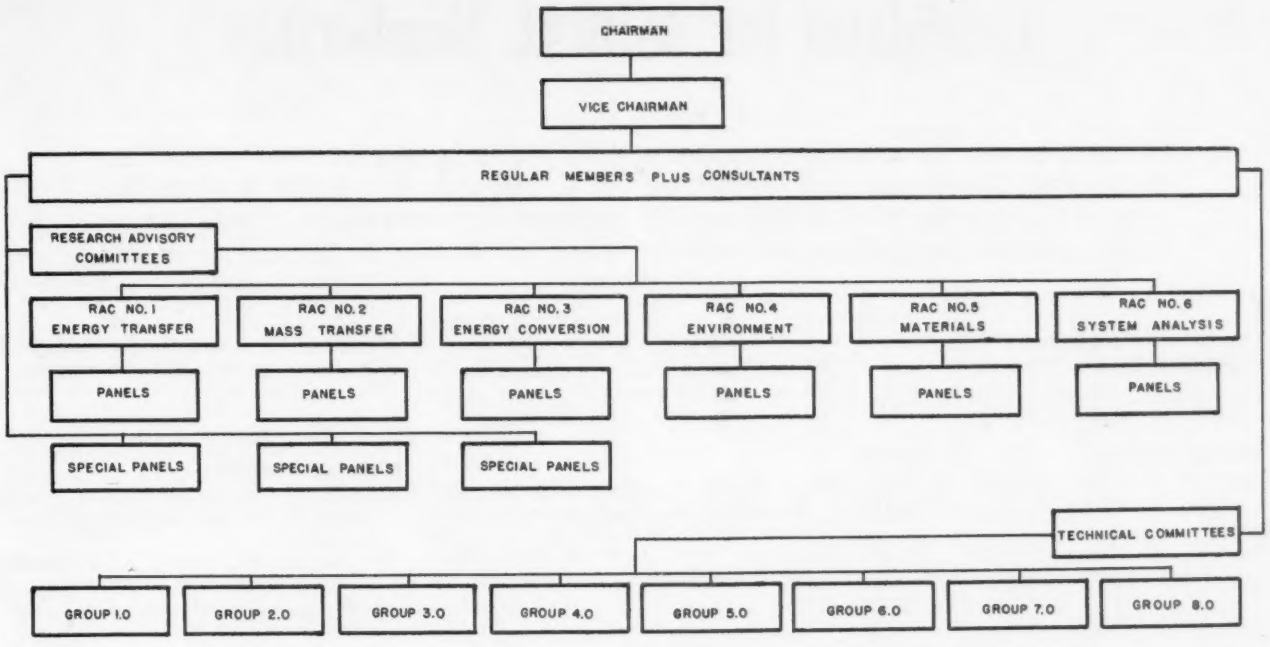
- Research Panel on Physiological Research and Human Comfort
- Research Panel on Sound and Vibration Control
- Research Panel on Hydronics
- Research Panel on Combustion
- Research Panel on Odors
- Research Panel on Energy Transfer through Fenestration
- Research Panel on Thermal Circuits

Each of these Panels will have specific assignments to perform and the Research Advisory Committees with the aid of the Research Panels will map out a recommended program of research activities for the Society. In this way the long-range research objectives of the Society can best be defined and implemented. For a more detailed discussion of the problems which face our Society in the fostering of its research program the reader is referred to the Research Page of the September 1959 issue of the ASHRAE JOURNAL.

In addition to the Research Panels which will operate in conjunction with the Research Advisory Committees, additional Panels will be formed from time to time to advise the Research and Technical Committee directly on problems of broad implication. Three such Panels have already been formed. The first of these is the Panel on Refrigeration chaired by E. P. Palmatier and charged with the task of outlining a refrigeration research program for our Society. The need for such a Panel was evident when it was recognized that the research activities of our two merging societies were not equally well developed.

Another Panel reporting directly

(*Continued on page* 104)



Technical Group 1.0 Basic Theory and Materials

1.1 Heat Transfer and Fluid Flow
1.2 Thermodynamics
1.3 Psychrometrics
1.4 Thermoelectricity
1.5 Meteorology and Weather Data
1.6 Combustion and Fuels
1.7 Solar Energy Utilization
1.8 Corrosion — Causes and Control
1.9 Refrigerants and Lubricants
1.10 Brines
1.11 Thermal Insulation and Vapor Barriers
1.12 Definitions and Nomenclature
1.13 Sorbents and Desiccants

Technical Group 2.0 Basic Equipment

2.1 Reciprocating and Rotary Compressors
2.2 Centrifugal and Axial Flow Compressors and Blowers
2.3 Absorption and Steam Jet Refrigeration
2.4 Coils, Fan-Coil Units, Air-Cooled Condensers
2.5 Liquid Heat Exchangers — Water-Cooled Condensers
2.6 Water Conservation Equipment, Water Treatment
2.7 Grilles, Fans, Air Distribution Equipment
2.8 Air Cleaning Equipment

Complete membership of all research and technical committees and panels will be published in future issues.

Technical Group 3.0 Auxiliary Equipment

3.1 Controls and Valves
3.2 Motors and Motor Starters
3.3 Pumps and Piping
3.4 Instruments and Instrumentation

Technical Group 4.0 Systems

4.1 Comfort and Industrial Air Conditioning
4.2 Marine Refrigeration and Air Conditioning
4.3 Ultra-Low Temperature Systems and Test Chambers
4.4 Air Cycle Refrigeration
4.5 Hot Water and Steam Heating

Technical Group 5.0 Heating and Refrigeration Loads

5.1 Load Calculation and Design Conditions
5.2 Thermal Circuit Analysis
5.3 Fenestration

Technical Group 6.0 Environmental Control and Effects

6.1 Physiology and Human Environment
6.2 Acoustics and Vibration Control
6.3 Odor Cause and Control
6.4 Industrial Environment

Technical Group 7.0 Unitary Equipment

7.1 Commercial Food Storage and Dispensing Equipment
7.2 Domestic Refrigerators and Unit Food Freezers
7.3 Truck and Railway Car Refrigeration Units
7.4 Drinking Water and Beverage Coolers
7.5 Ice Makers
7.6 Air Conditioners and Dehumidifiers
7.7 Railway and Vehicle Air Conditioning
7.8 Milk Coolers

Technical Group 8.0 Products and Processes

8.1 Meat and Fish Products
8.2 Dairy, Poultry and Allied Products
8.3 Fermentation Processes and Allied Products
8.4 Concentration, Dehydration and Other Food Preservation Processes
8.5 Agricultural Products
8.6 Frozen Foods
8.7 Ice Making, Skating Rinks and Industrial Refrigeration
8.8 Cold Storage Warehouses and Locker Plants

Candidates for ASHRAE Membership

Following is a list of 162 candidates for membership or advancement in membership grade. Members are requested to assume their full share of responsibility in the acceptance of these candidates for membership by advising the Executive Secretary on or before January 31, 1960 of any whose eligibility for membership is questioned. Unless such objection is made these candidates will be voted by the Board of Directors.

Note:
* Advancement † Reinstatement

REGION I

Connecticut

COADY, J. J., Br. Mgr., Powers Regulator Co., Newington.

Massachusetts

BEST, P. M., Sales Promotion & Education, H. B. Smith Co. Inc., Westfield.
HARRIS, R. G., Estimator, Rhode Island Covering Co., Rehoboth.
MCKEE, J. G., Sales Engineer, R. T. Forbes Co. Inc., Newton Highlands.
PORTER, D. G., Sales Engineer, Johns Manville Sales Corp., Boston.

New Jersey

HOELZ, C. R., Asst. Engr., Bishops' Dairies, Riverside.
KAPLAN, P. A., Appl. Engr., Worthington Corporation, East Orange.
OSTERGAARD, P. B., Sr. Engr., Lewis S. Goodfriend & Assocs., Montclair.

New York

ARNOLD, J. S., Chief Engr., Kool Air Systems, Inc., Valley Stream, L. I.
BARBERA, J. A., Associate, Clyde Alston, Hempstead, L. I.
BEKOFF, SHEPHERD, Sales Engineer, Fleet Utilities Co., Inc., Inwood, L. I.
BIEDLER, R. T., Advertising Mgr., ASHRAE, New York, N. Y.
DIETRICHSON, A. C., Engr., Carrier Corp., Syracuse.
FURTAW, R. B., Draftsman, W. A. Di Giacomo Associates, New York.
GREEN, L. S., Vice-Pres. of Sales, Air Filter Maintenance, New York.
HNOJSKY, OLDRICH, Proj. Engr., Voorhees Walker Smith Smith & Haines, New York.
HOFMANN, F. W., Asst. Secretary, ASHRAE, New York, N. Y.
HULL, R. B., Asst. Squad Leader, Board of Education, New York.
KENNER, JOSEPH, Pres., Kool Air Systems, Inc., Valley Stream, L. I.
KORN, PAUL, Pres., Charge of Sales Production, Air Filter Maintenance, New York.
LAINE, M. T., Estimator-Draftsman, Eugene Duklauer, Inc., New York.
MARRAN, F. L., Partner, Marrans Oil Burner Service, Patchogue, L. I.
PERTSCHUK, Leo, Vice-Pres., Kool Air Systems, Inc., Valley Stream, L. I.
REHMANN, C. T., Sales Mgr., Wymbs, Inc., Bronx.
SCHROEDER, ALFRED, Associate Member of Firm, W. A. Di Giacomo Associates, New York.
SLAVIN, WILLIAM, Chief Engr., Fellheimer & Wagner, New York.
SOLARI, F. J., Chief Engr., Equitable Life Assurance Society of United States, New York.
VAN ADELSBERG, M. M., Dev. Engr., Carrier Corp., Syracuse.
WALDRON, C. F., Estimator, Wallice & Co., Huntington Station, L. I.
WALLICE, W. S., Design, Installation, Wallice & Co., Huntington Station, L. I.
WALLICE, JACK, Owner & Mgr., Wallice & Co., Huntington Station, L. I.

REGION II

Canada

BARBER, R. H., Special Repr. Promotional Sales, Crane Ltd., Montreal, Quebec.
BARRENGER, M. J., Sales Repr., Amalgamated Electric Corp. Ltd., Ottawa, Ont.
BJERRING, K. H., Mech. Engr., J. Stevenson & Assocs., Calgary, Alta.
BOOTH, S. C., Estimator, Canadian Comstock Co. Ltd., Edmonton, Alta.
BUCKLER, G. W., Mgr. Htg. Dept., Crane Ltd., Hamilton, Ont.
CAMPBELL, F. S., Coml. Sales, Honeywell Controls, Ltd., Edmonton, Alta.
CARSCALLEN, G. F., Sales Engr., Dunham-Bush Ltd., Ottawa, Ont.
CUCCIA, J. D., A-C Engr., Jas. P. Keith Associates, Montreal, Que.
DAVIS, E. J.,† Engr., Gurney Foundry Co. Ltd., Toronto, Ont.
FEINMAN, L. J., Mgr. Store Maint. Dept., Steinberg's Ltd., Montreal, Que.
FOWLER, V. P., Sales Repr., Sheldon Engineering Ltd., Toronto, Ont.
GOMAN, W. C., Dist. Engr., Canada Blower & Forge, Hamilton, Ont.
HEANEY, W. C., Sales Engr., Farr Company Manufacturing Ltd., Montreal, Que.
KEITH, D. E., Sales Repr., Crane Ltd., Montreal, Que.
KENNEFORD, RONALD, Repr., Honeywell Controls, Ltd., Edmonton, Alta.
LEICESTER, P. H., Engr. in Training, Angus Butler & Assocs., Edmonton, Alta.
LESTER, R. W., Chief Draftsman, Keith Assoc. Ltd., Westmount, Que.
MILLEN, C. T., Sales Supv., Fiberglas Canada Ltd., Toronto, Ont.
NOREAU, C. A., Sales Mgr., Mechanical Appliance & Transmission Co., Montreal, Que.
OVERBURY, M. R., Sales Engr., Dunham-Bush Ltd., Ottawa, Ont.
PALMER, E. H., Pres., Palmer Heating & Air Conditioning Inc., Montreal, Que.
SCHACHTLER, R. J., Chief Mech. Engr., Beauchemin-Beaton-Lapointe, Montreal, Que.
SOMERVILLE, R. W., Engr., Carrier Engineering, Ltd., Calgary, Alta.
SWEENEY, D. J., Br. Mgr., Trane Co. of Canada, Toronto, Ont.
WIBER, H. G., Design Engr., Angus, Butler & Assocs., Edmonton, Alta.

REGION III

District Columbia

FRANCE, C. N.,† Partner & Sales Engr., T. W. McGuire Co., Washington.
STEURER, R. W., Indus. Sales Engr., Dunham-Bush, Inc., Washington.
ZELLER, C. J., Sales Engr., Farr Company, Washington.

Maryland

KRUGER, W. H., III, Proj. Mgr. & Estimator, Riggs Distler & Co., Inc., Baltimore.
SCHOFIELD, J. B.,* Design Engr., Lloyd E. Mitchell Inc., Baltimore.

Pennsylvania

BURKART, A. C., Assoc. Sr. Engr., Philadelphia Electric Co., Philadelphia.
MATTERN, G. A., Indl. Power Engr., West Penn Power Co., Jeannette.
MEARNS, J. R., Field & Design Engr., C. S. Leopold, Inc., Philadelphia
RODDIS, L. H., JR., Pres., Pennsylvania Electric Co., Johnstown.

REGION IV

Florida

GABEL, M. L., Mgr., Bryant Heating Specialists Co., Tampa.
HARGAN, J. H., Partner, Charles T. Healy & Assoc., Tampa.
JOUGHIN, L. E., Jr., Vice Pres. Joughin Plumbing Co., Tampa.
WABERSKI, T. L., Proj. Engr., Typhoon Heat Pump Co., Tampa.
WILLIAMS, G. S., Gen. Mgr., Southern Mechanical Contractors, Tampa.

Georgia

EMBRY, B. W.,† Mfrs. Agent, Atlanta.
SCHUCK, M. J., A-C. & Hgt. Mgr., Savannah Gas Co., Savannah.

REGION V

Indiana

CROSTHWAIT, D. N., JR., Engrg. Consultant, Dunham-Bush, Inc., Michigan City.
DOBROWOLSKI, MARIAN, Engrg. Aide, Everett I. Brown Co., Indianapolis.
SLEPICKA, I. M., Br. Coml. Sales Mgr., Minneapolis - Honeywell Regulator Co., Indianapolis.

Ohio

COCHRAN, R. H., Engr., Smith & Oby Co., Cleveland.
GENTER, D. P.,† Sales Engr., American Standard, Industrial Div., Toledo.

HANDLEY, C. E., Sales Engr., Sherman & Weager, Inc., Columbus.
LUSK, J. F., Sales Repr., Bridgeport Brass Co., Cincinnati.
MONNIN, H. J.,† A-C. Engr., General Electric Co., Cincinnati.

REGION VI

Illinois

ANSLEY, E. C., Vice-Pres., Smitty's Htg. & Air Cond. Co., South Holland.
BLACHOWICZ, B. S., JR., Engr., Schmidt, Garden & Erikson, Chicago.
HARTOUGH, B. R., Appl. Sales Engr., General Electric, Peoria.
LIEBERMAN, I. F., Mech. Engr., Neiler, Rich & Bladen, Chicago.
PETERSON, J. M., JR., Repr., Bell & Gossett Co., Morton Grove.
REGINSKI, J. M., Cons. Engr., Chicago.
ZUZULY, W. S., Design Engr., Frank W. Riederer & Assoc., Chicago.

Michigan

SNYDER, R. P., Indl. Insulation Sales, Owens Corning Fiberglas Corp., Detroit.
VOGEL, M. L., Mathematician & Design Analyst, Eaton Manufacturing Co., Detroit.

REGION VII

Alabama

JUDD, J. H.,* Dist. Mgr., Buffalo Forge Co., Birmingham.

Louisiana

ALEXANDER, J. H.,† Sales Engr., A. M. Lockett & Co. Ltd., New Orleans.
HAMRICK, J. W., JR., Sales Engr., Ilg Electric Ventilating Co., New Orleans.
PLANTE, JACQUES, Engrg. Estimator, Airco Refrigeration, New Orleans.

Missouri

BOCCI, P. P.,† Partner, Be V Sales Co., Inc., St. Louis.
PRINZ, EDWARD, Field Engr., Pittsburgh Plate Glass Co., Webster Groves.
THOMAS, C. D., Tech. Repr., Worthington Corp., St. Louis.
WARD, C. L., JR., Br. Mgr., Barber-Colman Co., Kansas City.

Tennessee

ERB, H. E., III, Sales Engr., G. H. Avery Co., Memphis.
LEDBETTER, N. C.,† Sales Engr., Trane Co., Memphis.
MONTGOMERY, J. H., Secy. Treas., Garrett-Montgomery, Inc., Memphis.

REGION VIII

Louisiana

ROBERTSON, W. C., Field Engr., Square D Company, Shreveport.

Texas

MOZISEK, A. R., Industrial Dev. Mgr., Dallas Power & Light Co., Dallas.
SCHROEDER, C. K., Refr. Engr., Friedrich Refrigeration, Inc., San Antonio.

REGION IX

Colorado

BUEHLER, L. L., Associate, Francis E. Stark, Cons. Engr., Denver.
MCFARLAN, E. R.,* Engr., Minneapolis-Honeywell Regulator Co., Denver.

Nebraska

ALVINE, R. A., Mech. Engr., Leo A. Daly Co., Omaha.
GESSNER, G. A.,† Engr., Natkin & Co., Omaha.
RIX, J. J., Sales Engr., American Standard, Industrial Div., Omaha.

REGION X

British Columbia

HOOGE, HELMUT, Design Engr., D. W. Thomson & Co. Ltd., Vancouver.
ROSE, J. W., Dist. Mgr., Trane Co. of Canada, Ltd., Vancouver.

California

AKIZUKI, E. S.,* Sales Engr., Norman S. Wright & Co., San Francisco.
BACHMAN, D. R.,† Coml. Mgr., Powers Regulator Co., San Francisco.
BISHOP, J. R.,† Sales Engr., California Hydronics Corp., San Francisco.
BREWTON, C. E., JR., Sales Engr., Sterling Electric Motors, Inc., San Francisco.
COYNE, R. F.,* Div. Engr., Albert C. Martin & Assoc., Los Angeles.
KELLY, L. A., Bldg. Mgr., California Federal Savings Bldg., Los Angeles.
LEFLER, R. T., Designer, Gayner Engineers, San Francisco.
PATEL, K. R.,* Chief Engr., K. R. Patel & Associates, Los Angeles.

Oregon

BILLINGS, D. E., Sales Engr., E. S. Constant Co., Portland.
PEDERSEN, HARRY, Repr., J. M. Harder Plumbing & Heating Co., Portland.
SMITH, W. J., Coml. Marketing Engr., Lennox Industries Inc., Portland.

Washington

BREEDING, L. E., Mech. Engr., Bouillon Griffith & Christofferson, Seattle.
GAREN, D. R., Mech. Engr., U. S. Army, Corps of Engineers, Seattle.
GORDON, W. S., Cons. Electrical Engr., Tacoma.
JOHNSON, E. D., Owner, Gene Johnson & Assoc., Spokane.
LANDERHOLM, R. E.,* Partner, Wood & Landerholm, Cons. Engrs., Spokane.

Panama

BETTIS, R. M., Pres., Tropelco, S. A., Panama.

Alaska

CREWS, P. B., Owner, Paul B. Crews, Mech. Engrs., Anchorage.
FISHER, E. N., Coml. Installation Engr., Minneapolis-Honeywell Regulator Co., Anchorage.

FOREIGN

Australia

WHITAKER, J. R., Cons. Engr., Melbourne, Victoria.

Denmark

KORSGAARD, VAGN, Head of the heat insulation research laboratory, The Technical University of Denmark, Copenhagen.

England

BROOKS, W. G., Chairman & Managing Dir., Brooks Air & Heat Systems Ltd., London.

France

FOUGERON, P. E., Tech. Mgr., Ste L'Air Conditionne "AIRWELL," Chatou.

Indonesia

LIAN, H. H., Chief Engr., Refr. & A-C. Dept., Electro-Import, Djakarta.

Italy

BIANCIARDI, LEOPOLDO, Chief Engr., Designing Dept., Marelli Aerotecnica, Milan.
CANTELE, MARCELLO, Engr., Dell-Orto Chieregatti S.p.A., Milan.
GUENZATI, FERMO, Owner, Officina Termotecnica Guenzati, Milan.
IELO, ORESTE, Chief Engr., Civil A-C. Dept., Aerotecnica Marelli, Milan.
LUCCA, GIORGIO, Tech. Mgr., S.p.A. Ing. G. Radaelli, Milan.
PERONDI, ERNESTO, Tech. Mgr., S.I.-T.I.S. S.p.A., Milan.
PICCININO, OSCAR, Cons. Engr., Milan.
REDAELLI, CARLO, Co-Owner, S.I.T.I.S. S.p.A., Milan.
RUIZ DE CARDENAS, ROBERTO, Owner, De Cardenas, S.p.A., Milan.
ZANCHI, UMBERTO, Co-Owner, S.I.T.-I.S. S.p.A., Milan.

Venezuela

ANGHELOFF, VENZISLAV, Engr., York Venezuela C.A., Caracas.
MANTELLINI, A. F., Mech. Engr., La Electricidad De Caracas, Caracas.

Western Germany

LANGE, OTTO, Cons. Engr., Stuttgart-Zuffenhausen.

Yugoslavia

ALEKSIC, ZARKO, Engr. Designer, Projektni Zavod, Srbija-Projekt, Belgrade.
ANDREVJEVSKI, BLAGOJE, Engr. Designer, Jugoprojekt, Skopje.
ANTONIC, NEBOJSA, Engr. Designer, Instalacija, Novi Sad.
RUZIC, ALEKSANDAR, Engr. Designer, Projektantski Zavod Recnog, Saobracaja, Bedgrad.

STUDENTS

BARNETT, J. H., JR., A & M College of Texas, College Station, Texas.
CALLAWAY, F. R., A & M College of Texas, College Station, Texas.
GOODE, W. B., JR., A & M College of Texas, College Station, Texas.
HAHN, R. A., A & M College of Texas, College Station, Texas.
LENZEN, M. E., A & M College of Texas, College Station, Texas.
MCLANE, T. C., A. & M. College of Texas, College Station, Texas.
MURPHY, J. E., California State Polytechnic College, San Luis Obispo, Calif.
PERKINS, R. H., A & M College of Texas, College Station, Texas.
SIMANK, J. B., JR., A & M College of Texas, College Station, Texas.
STONE, P. W., A. & M. College of Texas, College Station, Texas.
SUTPHEN, B. L., A. & M. College of Texas, College Station, Texas.
WEATHERS, J. L., Evansville College, Evansville, Ind.
WHITLOCK, P. L., A & M College of Texas, College Station, Texas.

What ASHRAE Regions and Chapters are doing

Cooperation between architect, engineer, contractor and equipment supplier towards the successful completion of a project concerned several Chapters; noted in the wide range of topics presented at other meetings were refrigerant driers, noise control, thermoelectric refrigeration, psychrometric charts and relative merits of gas, oil and electricity for heating.

KANSAS CITY . . . Conflict on the boundary between Regions VII and VIII was not resolved at the regional meeting, L. A. Heaven, Chapter President, reported at the November 2nd meeting. Probable solution to this problem, he stated, would be selection of the two eastern counties along the Kansas-Missouri line plus Shawnee and Osage Counties in Kansas as the western boundary of Region VII and the Kansas City Chapter. At some time in the future, a chapter will probably be formed in Topeka, reducing the area of this chapter, in Kansas, to a one county depth west of the Kansas-Missouri line.

Ray C. Edwards, Edwards Engineering Corporation, traced the development of air-cooled gravity condensers, the advantages and disadvantages of air-cooled gravity condensers and the methods of control in the evening's technical session. His talk was illustrated with slides and charts.

GOLDEN GATE & SACRAMENTO . . . Holding their annual joint meeting on November 12th, these Chapters presented a panel discussion on "Plans and Specifications." Exploring the intent of the engineer in preparing his plans and specifications to see if this coincides with the contractor's and equipment supplier's ideas were Karl Guttman, Kasin, Guttman & Malayan, Moderator; John Linford, Linford Air & Refrigeration Company, contractor; Daniel D. Vandament, Vandament & Darmsted, engineer; and Thomas White, American Blower, equipment supplier.

PHILADELPHIA . . . On November 21st this Chapter held a Heating Seminar Meeting at the University of Pennsylvania; featured in an all-day program were three speakers in the morning and two in the afternoon.

Presented as the first lecture was "Physiological effects of comfort conditions," a review of the importance of temperature and humidity on the human body by Dr. Robert Denton of the University's Hospital and Medical School. Special emphasis was placed on some of the problems of the upper respiratory tract, caused by poor environmental conditions.

Next, Louis Webster of Carrier Corporation explained the use of the psychrometric chart, discussing its practical design advantages.

Various types of boilers currently in use and their development were the subject of a talk by Joseph Weigard of Superior Combustion Company, third speaker of the day. He reviewed procedure for checking efficiency of a boiler operation and presented a guide for predicting results. He concluded his address with a resume of firing equipment and controls.

At the afternoon session Samuel Miller, Nesbitt Company, spoke on hot water heating, describing one-pipe, two-pipe and reverse return systems. Various controls and operation curves were discussed.

Several types of instruments for the testing and balancing of heating and air conditioning equipment were demonstrated by Robert Barefoot of duPont Company as concluding speaker of the meeting. Instruments shown were those measuring temperature, fluid flow rate, vibration air flow, noise level and speed.

Announced at the close of the day's activities was a Refrigeration Seminar, to be held in March.

WISCONSIN . . . Two speakers presented discussions at this group's November 16th meeting, the first on the topic "Problems of Controls," the second on "Refrigerant Driers."

Preliminary speaker was Harold Alyea of Johnson Service Company, who outlined twelve major points to be considered when selecting controls, as well as the problems which could result if these points are ignored. Of major importance, in the speaker's opinion, was that the selection of the controls should be left to someone familiar with all applications.

Outlining what refrigerant driers do and how they aid in removal of water, acid, metal salts, metal oxides and other undesirable substances from a system, John Bopp of Ansul Chemical Company stressed

CHAPTER MEETING DATES

	Jan.	Feb.	Mar.
Alamo	19	16	15
Arkansas	19	16	23
Atlanta	11	8	14
Austin	—	—	—
Baltimore	7	4	3
Baton Rouge	20	17	17
Boston	19	16	15
British Columbia	—	—	—
Central Arizona	—	—	—
Central Indiana	—	—	—
Central Michigan	12	9	8
Central New York	13	10	9
Central Oklahoma	11	8	14
Central Pennsylvania	—	10	—
Cincinnati	5	2	2
Cleveland	—	—	—
Columbus	18	15	21
Dallas	18	15	21
Dayton	6	3	2
El Paso	—	—	—
Evansville	5	2	1
Florida West Coast	19	16	16
Fort Worth	20	—	—
Golden Gate	7	4	3
Hampton Roads	—	—	—
Houston	15	19	18
Illinois	11	8	14
Illinois-Iowa	18	15	21
Inland Empire	11	8	8
Iowa	12	9	8
Jacksonville	5	5	1
Johnstown	12	9	8
Kansas City	4	1	7
La Ville de Quebec	4	8	14
Long Island	11	8	8
Louisville	—	—	—
Manitoba	28	25	24
Memphis	18	21	20
Michigan	18	15	21

the importance of keeping heat in the system to a minimum, as this affects the system's stability and aids production of the foreign substances. Defining a drier as a mechanism controlling, at one point in the system, all impurities which the refrigerant has "scrubbed out," speaker Bopp recommended use of a drier and a vacuum pump in all systems.

NORTHEASTERN OKLAHOMA . . . Basing the first portion of his talk on presentation of information contained in the GUIDE Chapter on Sound Control, Charles N. Rink of Industrial Acoustics Company, Inc., presented a discussion on "Noise Control in Air Conditioning Systems" at a recent meeting of this Chapter.

Following this introduction, he presented an explanation of the basic problems confronting sound control and the methods of estimating the amount of control necessary to obtain desired results within any given space. Sound traps, which collect the sound energy and allow it to dissipate as minute quantities of heat, were discussed.

Speaker Rink pictured high and low frequency noises as demanding different types of treatment, since the high frequencies can be absorbed in various substances, while lower ones can be handled only through sound traps.

General conclusion was that a possible cost savings might be gained through use of economical equipment with a high sound level, to be lowered to the desired range through use of proper acoustical treatment, rather than purchasing more expensive equipment with a low sound level.

JOHNSTOWN . . . Moderator of a panel on "Merits of Gas, Oil and Electricity for Heating Residences and Small Commercial Buildings," at the November meeting, was Dr. Walter L. Ross, a Chapter member.

Outlining certain "musts" for fuel for heating, Wallace Sheppard of Peoples' Natural Gas Company stressed that there should be a dependable supply with an extensive amount in storage, it must be ready to use when received in the home, efficient as a fuel and with no resulting odor, susceptible to automatic control and low in cost. Quoting gross figures based on local costs, he indicated that one cent worth of gas can supply 12,500, oil 9100, hard coal 12,750 and electricity 1950 Btu.

R. E. Dart of Gulf Oil Company, the second speaker, told of a new method for refining heating oil that may provide a better oil without objectionable odors. In addition to this process, he stated that various companies are working to develop more efficient burners for this fuel. Advantages cited for oil as a heating medium were ease of storage, lack of evaporation, low cost and its resistance to ignition when in bulk form.

Pointing out that the number of users of electric heat has been increasing steadily, Robert L. Boyd of E. L. Weigand Company stressed its growing acceptance as an indication of preference for a clean heat source, even though at slightly higher cost. A major advantage of electric heating, he said, is its great flexibility of application.

TOLEDO . . . Touring the L.O.F. Building, members and guests attending the November meeting were first introduced to the mechanical system by E. Pita of Guy Panero and Associates. Later, he reported on some of the problems encountered in design of the building, accompanying his commentary with a slide presentation.

COLUMBUS . . . Starting with an explanation of what each group of lines on the chart represents, Professor William Rudoy of the University of Pittsburgh's Mechanical Engineering Dept presented the topic "ABC's of the Psychrometric Chart" at a recent meeting. Colored slides illustrated his talk, which was punctuated by specific examples and answers to questions from the audience.

NEW YORK . . . As one of the official delegates representing the United States, Carl F. Kayan, Professor of Mechanical Engineering, Columbia University, presented a report at the November meeting on the International Institute of Refrigeration meetings which took place in Moscow and Prague in the fall of 1958 and Copenhagen in August, 1959. In conclusion he devoted some attention to the national and international aspects of the drive towards adoption of the metric system by the United States.

LOUISVILLE . . . Around 1925 our national economy passed from a state of need to a state of material excess, permitting freedom of choice on the part of the consumer. As a result, industrial design was born. Explaining this still relatively new profession before the November meeting, Richard Latham of Latham, Tyler and Jensen, pointed out industrial design's place among marketing, manufacturing and engineering.

An exponent of the planning approach in product development, the speaker stated that although

	Jan.	Feb.	Mar.
Middle Tennessee	12	9	8
Minnesota	11	8	14
Mississippi	25	22	28
Mobile	—	—	—
Montreal	18	15	28
National Capital	5	2	1
Nebraska	12	—	8
New Mexico	19	16	15
New Orleans	28	15	15
New York	26	23	29
Niagara Frontier	—	—	—
North Alabama	—	—	—
North Alberta	—	—	—
North Jersey	7	4	3
North Piedmont	15	—	—
Northeastern New York	—	—	—

	Jan.	Feb.	Mar.
Northeastern Oklahoma	18	15	21
Northern Connecticut	14	11	10
Ontario	—	—	—
Oregon	14	13	17
Ottawa Valley	—	—	—
Philadelphia	—	11	10
Pittsburgh	18	15	21
Puget Sound	—	—	—
Rhode Island	13	10	16
Richmond	4	1	7
Rochester	6	3	2
Rocky Mountain	6	3	2
Sacramento Valley	—	—	—
St. Louis	25	11	28
San Diego	13	10	10
San Joaquin	19	16	15

	Jan.	Feb.	Mar.
Savannah	19	16	15
Shreveport	21	18	17
South Carolina	18	15	21
South Florida	12	9	8
South Piedmont	—	—	—
Southern Alberta	—	—	—
Southern California	11	8	14
Southern Connecticut	12	9	8
Toledo	11	—	7
Tucson	—	—	—
Utah	—	—	—
West Texas	25	22	28
Western Massachusetts	—	—	—
Western Michigan	11	8	14
Wichita	19	16	15
Wisconsin	18	15	15

industrial design is now used by approximately 20% of all industry, its common concept is that of mere styling, which is considered a marketing adjunct of promotion and advertising. Where it really belongs, according to him, is as a part of the development team along with engineering. A program of design innovation, a study of the customers' needs and of the required product function, as well as styling, is what industrial design has to offer.

CENTRAL ARIZONA . . . "Treatment of Water for Air Conditioning Applications" was the topic presented at the October 5th meeting by William Wallace of Cone and Wallace Company. Outlining problems encountered and methods of water treatment in boiler systems, open-type systems involving evaporation of water and closed circulating water systems, speaker Wallace discussed relative effectiveness and reliability of the types of treatment for various sizes of the systems mentioned. Factors other than chemical hardness (e.g., algae and airborne dirt) were considered.

NATIONAL CAPITAL . . . Achievements in rocketry have introduced a new industry, designated the "space industry" by Robert Berner, Staff Engineer, Glenn L. Martin Company, who spoke on "Air Conditioning as Applied to Aircraft, Missiles and Rockets" at the November 3rd meeting. Discussed in his presentation were several air conditioning design problems. Cooling rather than heating was cited as being the main problem in aircraft at high speeds and altitudes, where air friction can cause plane surface temperatures as high as 550 F. Double shell construction, with efficient insulation between the layers, aids the air conditioning system.

Considerations for systems in commercial and military aircraft should, speaker Berner stated, include temperature variation (−40 to 100 F under normal operating conditions), heat compression rise due to forward motion, body storage index, maintenance of minimum oxygen pressure to sustain life, thermal lag, solar load, reverse of outside air infiltration and defogging due to rapid outside temperature change during descent.

Problems of sealed capsules in orbital flight are oxygen supply, removal of moisture and carbon dioxide and heat dissipation and absorption by radiation.

CLEVELAND . . . Air conditioning developments in the fields of office buildings, schools and industrial structures were discussed by a three-man panel at the second meeting of the season for this Chapter.

Covering the office building field was Robert Byers of Byers, Urban, Klug & Pittenger, who described systems ranging from package units to central station high velocity systems. Specific problems touched on included noise level of the air conditioning system and the need for recognition of the importance of humidity control.

Rapid growth of air conditioning in college buildings as opposed to its slower acceptance in elementary and secondary school levels was pointed out by Richard Jablonski of Fleming, Pfitzenmaier and Weeks. Architectural changes, particularly increased use of large amounts of glass with resultant problems of down draft and increased sun effect were considered by him, together with the trend to use of hot water systems.

Raymond Geiger of Austin Company reviewed several considerations in industrial air conditioning, including use of space with its effect on conditioning requirements and design, and problems of integrating heating, ventilating and air conditioning.

NEBRASKA . . . A documentation of pipeline and bridge construction for river crossings, "Pipeline in the Sky," was presented at the November meeting by C. A. McReynolds of Northern Natural Gas Company.

SOUTHERN CALIFORNIA . . . Commenting on the United Engineering Center Building Fund, ASHRAE President A. J. Hess, a guest at the November 9th meeting, urged support of this project and informed members of its progress.

"What do we know about the air around us?" questioned Dr. Alexander Goetz, Professor at California Institute of Technology, introducing a discussion of foreign particles in the air, in the 0.0001 to 0.000001 in. diam size range. These particles, observed by Dr. Goetz through use of a centrifuge and sensitized paper, are constantly being placed in the atmosphere by such natural means as breaking waves and artificially through chimney wastes. Removal of such particles may be accomplished by use of an absorption device such as an activated carbon filter.

CENTRAL OKLAHOMA . . . Illustrated with slides, a discussion of the theory and application of thermostatic expansion valves was presented by J. J. Mays of Sporlan Valve Company, guest speaker at the November 9th meeting.

NORTH JERSEY . . . Earl R. Shequine, Combustion Engineering, spoke on "High Temperature Hot Water Boilers" at this group's November meeting.

ROCKY MOUNTAIN . . . Comparing the York High-I Three Pipe Induction System to fan coil, double duct and conventional induction systems as used on multi-story buildings with large glass areas was George Brown of Borg-Warner's York Div. Major differences cited between this and the conventional systems are in the induction ratio and water piping supplying both hot and cold water to the individual units with the common return connection. Advantages claimed by speaker Brown relate to space, initial and operating costs, sanitation, flexibility and simplicity.

IOWA . . . Reporting on the Regional Meeting, R. S. Stover, a Chapter member, outlined the new territory of the Chapter, telling members that a request has been made to retain the Cedar Rapids, Iowa City and Waterloo areas within this territory.

Discussed by Dr. David J. Sutton, Senior Research Scientist for Honeywell, was "Air Quality, an Air

Conditioning Factor." Included in his talk were: air contaminants as solids, liquids, vapors and gases; air cleaning devices such as viscous, dry and electronic filters; factors affecting air cleaner performance; bases for determining efficiencies, such as weight, stain and particle count; and air cleaner applications.

EVANSVILLE . . . Through the use of charts, Robert L. Eichhorn of Whirlpool Corporation, reviewed the basic circuit of a thermoelectric refrigeration system, providing formulas for cooling and heating, including losses. Following this, he illustrated power input requirements, maximum coefficients of performance, properties of material used, maximum possible cooling, temperature drops and efficiencies and progress in materials used over the last few years.

At present, the maximum practical temperature difference with materials available is 65 F, with an expected T.D. of 100 F in the near future. These attainments are practical for various appliances, and as improvements occur, uses for thermoelectric refrigeration and heating should expand.

Points brought out in a question and answer period include the following: at high humidities and temperatures some trouble may develop with regard to life and durability; materials used in couples do not require as high purities as those used for semiconductors; the basis of the effect is the energy level in electrons; a system is designed to operate on a given current, rather than a given voltage, with ac operating through a transformer and silicon rectifier for power supply. Any rippling in the resultant dc power supply causes loss in capacity.

NEW ORLEANS . , . ASHRAE President A. J. Hess acted as moderator of a panel composed of Solis Sieferth, President of the New Orleans Chapter of the American Institute of Architects; Warren Moses of De Laureal and Moses; Thomas Sutter of R. P. Farnsworth Company; and Robert Rolston of Emile M. Babst Company. Discussed at the November 17th meeting was "Better Cooperation between Architects and Mechanical Engineers."

Representing the architect's position, Panel Member Sieferth stated that modern design, especially with respect to mechanical and engineering requirements, has brought into focus problems faced by the engineer in the maximum utilization of available space and cost factors. He felt that close cooperation between engineer and architect is not only desirable but essential, although costs may place limitations on the degree of mechanical consulting services which the project could carry.

Provision of continuous and complete job supervision rather than intermittent inspections would, in the opinion of Warren Moses, best fulfill the engineer's function. Although this would add to the engineering costs, he considers it to be in the best interests of the owner to provide the extra services.

Speaker Sutter agreed on these points, presenting the further information that the general contractor, to a greater extent than previously, must sub-contract phases of the work to specialists. Close cooperation and guidance by the mechanical design engineer would, he stated, contribute greatly toward obtaining the best performance from these sub-contractors.

Continuously faced with the necessity of making interpretations and determining solutions relating to layout and construction, the mechanical contractor, according to Robert Rolston, would welcome the possibility of having a representative of the design group more readily available for consultation and guidance.

FLORIDA WEST COAST . . . Discussing their respective responsibilities with regard to what is required of each in order to produce a complete structure satisfactory to the owner were Frank McLane, architect; Charles T. Healy, mechanical engineer; Flake Chamberliss, general contractor; Richard Steinholm, mechanical contractor; and Richard Peck, equipment supplier, panel members at the November meeting. Bidding and negotiating contracts, as well as what should constitute a reasonable guarantee and warranty for the best interests of the owner were considered.

FORT WORTH . . . "Gas Burners," as discussed by George C. Hergtholdt, Vice President and General Manager of Webster Engineering Company, was the topic presented at the November meeting.

ILLINOIS-IOWA . . . Decisions as to Chapter boundaries made at the Regional Meeting granted the additional counties of LaSalle, Livingston, Douglas, Piat, DeWitt and Logan to this Chapter, V. P. Demange reported at a recent meeting. Pending consideration at the February 6th Region V meeting is the addition of Macon, Mason, Sangamon, Menard and Schyler counties to the Chapter boundaries.

ROCHESTER . . . Members of a panel discussion on "Air Conditioning and Refrigerating Systems — Repair or Replace" were R. E. Cherne and A. L. Hartsig, consulting engineers, and H. J. Swartout of Eastman Kodak Company. Often plant engineers and management must decide between continued maintenance or modification of equipment and design or purchase of new equipment. With continuing improvements in the industry, the question arises of which is the more economical approach.

On December 2nd this Chapter held its fourth meeting of the season, with S. J. Stachelek of Rochester Industrial Insulations, Inc., showing a slide presentation, "Indoor Climates Affect Insulation Design," on behalf of Charles F. Gilbo of Armstrong Cork Company. Influence of outdoor conditions, or lack of it, on indoor temperatures and humidity was shown, together with conditions which can result if enclosed pipe areas, crawl spaces and such are improperly considered in building design.

In the second half of the program, Thomas Brien of Eastman Kodak Company described "Insulation Practices at Kodak Park," featuring in his talk demonstrations of self-foaming polyurethane insulation.

ASME Annual Meeting

reviews heat transfer and comfort physiology

Included in a truly mammoth program, the 1959 Annual Meeting of American Society of Mechanical Engineers, held in Atlantic City, N. J., November 30-December 4, had a number of formally prepared papers bordering upon heat transfer considerations of interest to those allied with heating and cooling. Also represented were similar discussions on the physiology of comfort.

Specifically, there were 36 papers presented at the Heat Transfer Section Meetings with 11 linking heat transfer and the individual. Some of these were: "The Role of Skin in Heat Transfer," as discussed by Alice M. Stoll, U. S. Naval Air Development Center. "The Effective Stimulus for Warmth Sensation in Man," by Edwin Hendler, Naval Air Material Center, and J. D. Hardy, University of Pennsylvania. "Sensory Reception and the Control of Temperature in Man," by T. H. Benzinger, Naval Medical Research Institute, and "Prediction of Heat-Stressed Skin Boundary Temperatures: Partial Rates of Change Associated with (a) Operative Temperature and Vapor Pressure (b) With Operative Temperature, Metabolism, and Evaporation, by L. P. Herrington, representing the John B. Pierce Foundation.

Other papers of general interest included a report upon the transfer of heat to Refrigerant 12 near the critical state in a natural circulation loop. The authors here were J. P. Holman, Aeronautical Research Lab., WADC, and J. H. Boggs, Oklahoma State University. "Thermal Comfort in Space Vehicles," by J. E. Janssen, Honeywell Research Center. "Thermal Contact Resistance in Finned Tubing," K. Gardner, Yuba Consolidated Industries, Inc., "A Theoretical Analysis of a Peltier Refrigerator," E. B. Penrod, University of Kentucky. "Climatic Considerations in the Design of Air-Cooled Heat Exchangers," G. F. Collins, Lockheed Aircraft Corporation, and R. T. Matthews, E. I. duPont de Nemours & Co., Inc. "Heat-Transfer Performance of Condenser Tubes," J. A. Stawicki and J. S. Ungar, Consolidated Edison Co. "Local and Average Heat-Transfer and Pressure-Drop for Refrigerants Evaporating in Horizontal Tubes," M. Altman, R. H. Norris, and F. W. Staub, General Electric Co. "A Systematic Approach to the Design of Compact Heat Exchangers," W. B. Hendry, Westinghouse Electric Corporation, and "A Small Free-Piston Engine-Compressor," J. H. McNinch, W. W. Vogelhuber, and R. J. McCrory, Battelle Memorial Institute.

Also included in the Heat Transfer Sessions was a four man panel discussion on "The Undergraduate Teaching of Heat Transfer." The speakers were Frank Kreith, University of Colorado; A. C. Mueller, E. I. duPont de Nemours & Co., K. G. Picha, Natural Science Foundation; and W. M. Rohsenow, Massachusetts Institute of Technology.

NWAHACA's higher 1960 budget in one third for

Better marketing

Warmly appreciative of the benefits already credited to a recently stepped-up Marketing Program, the Board of Trustees of NWAHACA has voted a sharply increased budget for 1960 (its highest ever) of which one third is allocated to public relations, merchandising and marketing phases.

Meeting for its 46th Annual Convention at the Chase-Park Plaza Hotels in St. Louis, Mo., December 1-4, the National Warm Air Heating and Air Conditioning Association paced many scheduled events to the Silver Shield Program for winter and summer certified air conditioning systems for indoor comfort. At the opening sessions on Wednesday, President Tom Byrd, presiding, made reference to "the greatest year air conditioning has ever had . . . no longer a luxury but a necessity . . . SELLING is the keynote of the program of this meeting."

Keith T. Davis as Chairman of the NWAHACA Research Advisory Council indicated that activities ahead would correspond closely with the three fields of (1) new products, new methods, new materials and local weather studies, (2) codes and standards relating to tests and installations and (3) field investigations supplementing es-

tablished work at the University of Illinois. Chairman Davis reported upon studies made with the fourth of a series of research homes at the University, the present one being a two-story three-level property with full inbuilt flexibility to permit controlled studies of interior air flow conditions and problems and corresponding control over some of the exterior walls in crawl areas and garages.

Supplementing the previous report, Research Associate E. J. Brown of the Department of Mechanical Engineering, University of Illinois, traced the design features of the house, reported upon the specific experience already gained there in heating functions and shortly to be covered in a NWAHACA Bulletin, indicated that the cooling phase would be reported upon in 1960 and that there were two programs at the University Laboratory nearing the final stages in regard to duct fittings and registers.

JUST ONE MANUAL

In a forthright determination to minimize the number of manuals of this association to which the designer must refer at present, the NWAHACA Application Engineering Council has established a program for a single manual, divided as to subject classifications and comprehensively treating each to cover forced air circulation design, whether for heating or cooling or both. There will be another manual for gravity systems.

In reporting upon marketing activities, Chairman Robert E. Main of the NWAHACA Marketing Council emphasized strongly the association goal of increased sales and profits, referred to the fact that the occasion was the first birthday of the Marketing Council and that the whole plan rested upon the concept of each member helping himself under the guidance of the Marketing Program. Responsibilities rest with the activities of five subcommittees.

As previously indicated, conspicuous attention was given throughout the meeting to the progress of the Silver Shield Plan and to various considerations allied with construction, financing, taxes, labor legislation, gaining and training of salesmen, preparation of surveys and cost estimates and to trends in electric heating, heat pumps and various aspects of ducted systems.

Tributes were paid to George Boeddener, retiring after nearly 20 years, and succeeded as Managing Director by James M. Martin, for the past three years Assistant Managing Director and Assistant Secretary-Treasurer. George Boeddener has been named Executive Vice President of the National Humidification Association, formerly the Humidifier Association.

Directly preliminary to the NWAHACA meeting, the North American Heating and Air Conditioning Wholesalers Association held its 13th Annual International Convention at the same location. Discussions, speakers and workshop panel sessions concentrated largely upon direct aspects of wholesale functions, distribution policy, educational programs and principles of management.

Others are saying—

that . . . . . savings in fuel and running costs resulting from use of packaged boilers largely outweigh any disadvantages, in this author's opinion. Among cited disadvantages is the fact that basic design has been for a specific type of liquid or gaseous fuel, with no consideration given to producing a unit which could be fired with solid fuel, nor be easily convertible to this. Other, minor, disadvantages, in relation to conventional boilers, are the necessity for provision of water treatment in order to prevent impairment of efficiency through build-up of scale and sizing of the boiler, when used for production of steam, to the precise load which it is going to feed, with no appreciable overload tolerated. *Journal of the Institution of Heating and Ventilating Engineers, September 1959, p 161 (British).*

that . . . . . large variation in heat transfer coefficient around the circumference of a horizontal tube evaporator was demonstrated in research conducted at the National College for Heating, Ventilating, Refrigeration and Fan Engineering, London. Results indicated that only a small part of the internal surface provides effective heat transfer. In these tests the liquid flowed along the bottom of the tube with the vapor above it; the author contends that this type of flow exists in most tubular evaporators. At higher velocities the flow becomes annular and the whole of the inside surface is effective. Reduction in evaporator length may be used to compensate for the increased pressure gradient. Improvements in evaporator design may result from further research, the author states. *Journal of Refrigeration, September/October 1959, p 118 (British).*

that . . . . . current lighting recommendations for commercial and industrial buildings have reached a point where the lighting load may have considerable influence on thermal design considerations, accounting for as much as 37% of the total air conditioning requirements in structures where 100 footcandles of general illumination are provided. Techniques combining certain aspects

(*Continued on page* 93)

WHO'S WHO IN ASHRAE

Insofar as possible, these listings will each appear twice a year

ASHRAE OFFICERS, COMMITTEES
See page 76, September JOURNAL

REGION AND CHAPTER OFFICERS
See page 76, October JOURNAL

RESEARCH AND TECHNICAL COMMITTEES
See page 82, this issue

STANDARDS COMMITTEE
See page 79, November JOURNAL

INTER-SOCIETY COMMITTEES
See page 80, July JOURNAL

Meetings ahead

February 1-4 – American Society of Heating, Refrigerating and Air-Conditioning Engineers, Semiannual Meeting, Dallas, Tex.

February 1-4–2nd Southwest Heating and Air-Conditioning Exposition, Dallas, Tex.

March 6-10 – National Association of Frozen Food Packers, 19th Annual Meeting, Chicago, Ill.

March 21-23–First National Electric House Heating Exposition, National Electrical Manufacturers Association, Electric House Heating Equipment Sect., Chicago, Ill.

March 29-31 – American Power Conference, 22nd Annual Meeting, Chicago, Ill.

March 30 - April 1 – Gas Appliance Manufacturers Association, Annual Meeting, White Sulphur Springs, W. Va.

April 4-7–Oil Heat Institute of America, 23rd National Oil Heat and Air Conditioning Exposition, New York, N. Y.

April 4-7 – Oil Heat Institute of America, Annual Convention, New York, N. Y.

April 5-7 – Building Research Institute, Spring Conferences, New York, N. Y.

April 27-30 – 3rd Western Air-Conditioning, Heating, Ventilating and Refrigeration Exhibit and Conference, Los Angeles, Calif.

May 1-4 – Air-Conditioning and Refrigeration Institute, Annual Meeting, Hot Springs, Va.

May 19-21 – Refrigeration Research Foundation, Annual Meeting, Denver, Col.

May 22-25–Industrial Heating Equipment Association, Hot Springs, Va.

May 22-26 – National Association of Refrigerated Warehouses, Annual Meeting, Denver, Col.

June 13-15–American Society of Heating, Refrigerating and Air-Conditioning Engineers, 67th Annual Meeting, Vancouver, B. C.

People

Cartis T. Roff, elected Vice President in charge of production and engineering of Anemostat Corporation of America, has made his headquarters at the company's Hartford, Conn. plant, and is responsible for design engineering and production of the line of air diffusers, high velocity air distribution systems and air meters. He joined Anemostat in 1946 as assistant to the President and was appointed Plant Manager of the Hartford facility in 1949.

John F. Tobin, with the company since 1923, has been appointed Vice President–Marketing of American-Standard's Industrial Div, in which position he will direct the div's complete marketing program. Prior to accepting his new assignment, he had been a regional manager for the same div. A University of Illinois graduate with a degree in mechanical engineering, he has served in a variety of sales management positions since joining the organization.

Ellis L. Phillips, deceased, was a Charter Member of the former ASRE. One of the early leaders in the electrical utility field, he obtained his electrical engineering degree from Cornell in 1895. Joining Westinghouse, Church, Kerr and Company as an engineer in charge of design and construction, he later organized the engineering firm of E. L. Phillips & Company and, in 1910, founded the Long Island Lighting Company, becoming its President the following year. He organized several other utility companies, including Rochester Central Power Company, Rochester Gas and Electric Corporation and the United Gas and Electric Corporation, and was a trustee of Northport Water Works Company.

George Boeddener, retiring Managing Director of the National Warm Air Heating and Air Conditioning Association, has been appointed Executive Vice President of the National Humidification Association, the appointment becoming effective January 1, 1960.

Robert C. Robertson has been promoted to Vice President in Charge of Sales for Acme Industries, Inc., a newly created position. He has been with Acme since 1957 as Director of Sales, after more than 30 years in sales management posts with such organizations as Chrysler Airtemp, Carrier and General Electric. Prior to joining the company, he was Manager of Marketing at General Electric's Home Heating and Cooling Div. An ASHRAE member, he is also an Associate Member of the Society of Naval Architects and Marine Engineers.

Ralph N. Hosey is rejoining the Drying Systems Div of Thor Power Tool Company as its New York representative. He previously was for six years an engineer in the Chicago Headquarters of the div before becoming New York District Sales Manager for L. J. Wing Manufacturing Company.

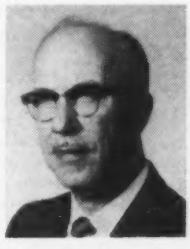
Stanley F. Gilman, formerly Associate Director of Research in Carrier Corporation's Research and Development Div, becomes Manager of Compressor Development for the Unitary Equipment Div. Dr. Gilman joined Carrier in 1953, leaving the University of Illinois, where he was Assistant Professor of mechanical engineering. A member of several national committees of ASHRAE, including the Research Advisory Committee on Controls and the Research Funds and Research and Technical Committees, he is also Chairman of the Region I Finance Committee and 1st Vice President of the Central New York Chapter.

Cecil Boling becomes EJC Vice President

Cecil Boling, President of Dunham-Bush, Inc., was elected Vice President of the Engineers Joint Council at the November meeting of the Board of Directors. President of the former ASRE at the time of the merger and first President of ASHRAE, he has a long record of service to the Society. A member since 1937, he has been Treasurer, 1st and 2nd Vice President; member of Council and the Executive, Steering and Inter-Society Relations Committees; and Chairman of the Technical Coordinating, Finance, Membership, Relations and Standards Committees.

William Hecht, retiring as President of Montgomery Engineering Company, becomes Chairman of the Board, remaining active in a consultant capacity. A pioneer in the field of air conditioning distribution, he founded the company in 1931.

Earle E. Trickler has been elected President of the Air Moving and Conditioning Association, Inc. Vice President of Marketing for New York Blower Company of Chicago, he has served on the AMCA Board of Directors and as Chairman of the Certified Ratings Committee and the Centrifugal Fan Div. Planning to utilize the results of recently completed investigations and research on air measurement methods, President Trickler stated that work is already underway on revision of the Association's methods of testing and standards for air moving equipment.



Harry H. Angus, a former member of ASHVE Council (1927-29), died recently at the age of 78. Head of his own business, H. H. Angus & Associates, Ltd., for many years, he had been a draftsman and designer for various organizations prior to its formation, among them Ingersoll Rand, Bethlehem Steel Company and Western Electric Company. He had helped to organize the Ontario Chapter, serving as its President, and was elected to Life Membership in 1949.

Harold A. Lockhart, Vice President and Chief Engineer, Bell & Gossett Company, and a former member of ASHAE Council, died on November 25th at the age of 53. Born in Nashville, Tenn., in 1906, he was raised in St. Paul and Minneapolis, receiving a Bachelor of Science in Mechanical Engineering degree from the University of Minnesota in 1929.

After graduation, he joined the Insulite Company in Minneapolis as Research Engineer, working on insulation board. He later was associated with the Stott Stoker Company, St. Paul, as Design Engineer and Production Manager. Since 1934 he had been Chief Engineer of Bell & Gossett, where he was in complete charge of the engineering dept. His promotion to Vice President was announced in 1955.

Active in the former ASHAE, he served on the Committee on Research, becoming Vice Chairman in 1956 and Chairman in 1957; on the Research Executive Committee and the Long Range Research Program. TACs on which he served were: Fluid Flow in Pipes; Panel Heating and Cooling, Group B; Hot Water and Steam Heating, as Vice Chairman, 1952-55; Sound

and Vibration Control, Chairman, 1952-55; Heating Load; and Plant and Animal Husbandry, Vice Chairman, 1956.

Co-author of several design and engineering manuals published by Bell & Gossett, he addressed many ASHAE Chapter Meetings. He was a licensed engineer in the State of Illinois and a member of the American Society of Mechanical Engineers.

Others are saying——

(*Continued from page* 91)

of air conditioning and lighting may provide a solution to this. Heat may be drawn off by ventilation in warm weather before it enters the occupied space or allowed to enter it in winter to reinforce or even replace the heating system. Winter heating load usually determines the size of a heat pump, with summer cooling capacity as an extra. If the lighting load can be combined with such a system, the resulting reduction in winter heating requirements may make the application of heat pumps more economical. *Illuminating Engineering, October 1959, p 615.*

that . . . . . rejected heat from refrigerant condensing units in modern supermarkets can be used in space heating the store, rather than being exhausted to the outside. In a cited installation, condensers are arranged in banks in one room, with the main fan unit for the ventilating system in an adjacent room. Return air is routed from the store through the condenser room in winter acquiring heat from the units before passing over the heating coils in the system to pick up the rest of the needed heat. As less heat is required, the controls are arranged to decrease the output of the heating coil first, and have it completely shut off before any action is taken to by-pass the air around the condenser room. *Canadian Refrigeration and Air Conditioning, September 1959, p 23.*

that . . . . . main shortcoming of the vortex tube as a source of cold is its low efficiency, which may be raised by utilizing the energy of the flows issuing from the tube. On introducing such measures as straightening out the cold flow, regenerating cold, ejecting the cold flow by the hot one, diminishing the length of the vortex zone and straightening out the hot flow, an efficient refrigerated chamber, of a temperature of —70° C, may be constructed. This unit has received widespread application. *Refrigeration Techniques (Xolodil'naya Technika), September-October 1959, p 8 (Russian).*

They Wanted to Know

Inquiries of the month to ASHRAE Headquarters covered many points as to technical facts, standards, practices, personnel and published references. From these, the following have been selected and condensed as being those replies of some general interest and value to ASHRAE members.

HEAT PUMPS FOR BUILDINGS

To ASHRAE:

We need the heat loss and cooling load calculations for a commercial building, the construction details, floor area and elevation of which are attached. We are considering the conditioning of this building with air-source packaged heat pumps so that effective zoning can be accomplished. Thus, it is quite important that the calculations and sizing of equipment be accurate.

E. M.

The Society does not enter into the consulting field. Information relative to load calculations may be found in the ASHRAE GUIDE, but you request specific figures for an individual design. We suggest that you submit your problem to manufacturers of air-to-air packaged heat pumps writing directly to their offices. We suggest also that you engage the services of a refrigeration and air conditioning consulting engineer. We can supply the names of consultants who are active in heat pump design if you would like to have them.

ENGINEERING REQUIREMENTS

To ASHRAE:

Ours is primarily a liberal arts institution but we do train a considerable number of students in basic subjects who go ultimately into engineering and allied fields. We are making a detailed study of the requirements for the various fields of engineering and studying suggestions by technical societies as to requirements for student training in their fields. It will be helpful to receive curriculum outlines and accrediting requirements for your society, as well as any suggestions as to where to find important recent studies allied with our investigation.

T. H. B.

You are certainly undertaking a progressive step in considering the addition of a Technical Department to supplement your regular liberal arts courses. The availability of additional training sources in technical subjects is extremely important to the future of our educational program as well as to the actual progress of our country. Many of the colleges and universities in the United States present courses of instruction in subjects allied with heating, refrigeration, air conditioning and ventilation. There are two with 4-year courses resulting in the award of a B. S. in this field. These are North Carolina College of Agriculture and Engineering and California State Polytechnic College. It is suggested that you contact these for copies of their courses of instruction in these fields.

As to requirements for student members in ASHRAE, there are two approaches. The basic procedure is to accept candidates from engineering courses accredited by ECPD. Where there are student applications from non-ECPD-accredited schools, our Education Committee initiates a review of the curriculum, quality of teaching, academic standing and other factors and then decides if such a school should be accredited by the Society. This has been done in several instances.

EDUCATIONAL FILMS

To ASHRAE:

As part of our Senior Project, one of the requirements for graduation from college, the group of which I am a member is required to produce a narrated film strip about air conditioning and refrigeration intended to attract students into this important field of engineering. Do you know of any installations which should be considered sufficiently unusual or interesting to be cited in such a project and do you have any material in your files upon which we might draw?

J. S. D.

We do not have any slides or films available here but we do have a list of those which may be obtained from various industrial and government sources. We enclose such a tabulation as well as a list of recently constructed buildings where air conditioning has been given concentrated attention by architects and engineers. You might write to the chief engineer of each for further information.

CURLING RINKS

To ASHRAE:

Can you help us locate published material regarding condensation and ventilation problems in connection with curling rinks? This has become quite an important matter in Canada, particularly in the early and later parts of the season when outside temperatures are higher than those inside. The introduction of outside air or ventilation during intervals of high humidity causes condensation on walls and ceiling. Under certain conditions this condensation will freeze on the steel members of the roof and, later, cause dripping on the ice to result in a poor surface.

W. L. B.

We suggest that you contact the Worthington Corporation for a copy of their booklet, "Ice Rinks". A similar pamphlet may be obtained from the Frick Company. Each includes information on permanent and portable rinks for skating and curling applications. There is a chapter in our Refrigeration Applications DATA BOOK as published by this Society titled "Skating Rinks" which also refers to curling areas. The chapter editor was R. A. Stencel of Toronto. Should you have any unanswered questions following the exploration of these suggested leads, the author might find it possible to be helpful.

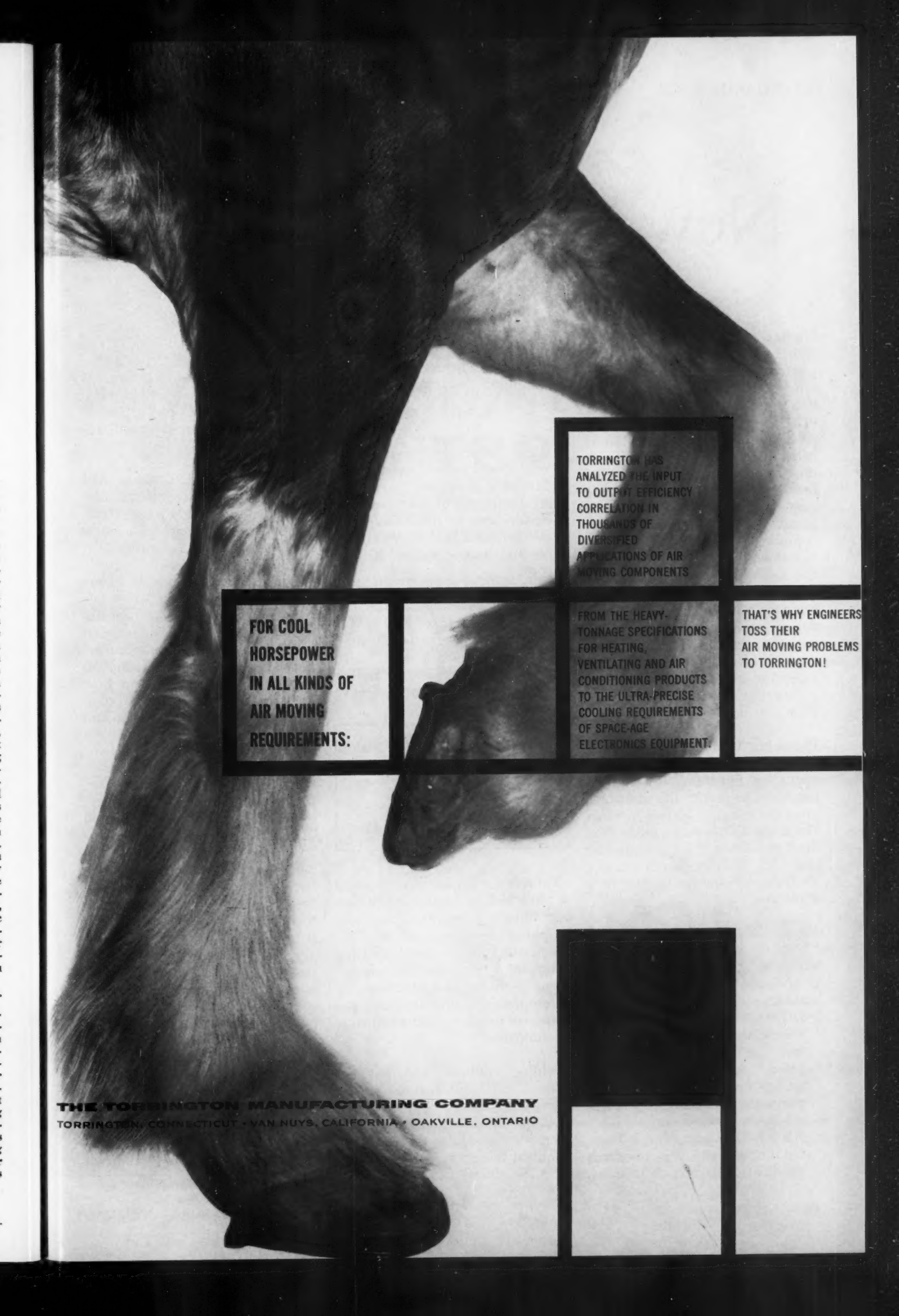
SHIPBOARD TESTS

To ASHRAE:

In specifying a means for determining the efficiency of the insulation of refrigerated space on board ships we have used: "With all the machinery shut down, the doors closed tight, and the compartment empty, the temperature rise from the specified temperatures shall not exceed an average of 2 F per hr for zero temperatures and below, and 1.5 F per hr for temperatures above zero, for a period of 6 hr. This test shall be made after the spaces have been brought down to the specified temperature with the machinery and held there for a minimum of 24 hr and shall be based on an ambient temperature of 85 F." The requirement for temperature rise in determining the efficiency of the insulation of an empty compartment appears to be unrealistic with the newly developed more efficient insulation materials, since the temperature rise is dependent upon the specific heat of the lining material inside the compartment assuming all other conditions are equal. Insulation materials of excellent thermal conductivity (k) yielding compartments with low overall heat transfer (u) are available, such as: refrigerant blown polyurethane foam and polystyrene foam. These materials may well result in a more efficient refrigeration system by minimizing the flow of heat from the adjacent space of high ambient temperature to the refrigerated space. However, these materials have very low specific heats, and might not meet the temperature rise requirement as specified. Your comments upon this procedure and established requirements and standards which apply would be most helpful.

E. S. S.

ASHRAE has a Standard on recommended procedures for the installation of marine refrigeration equipment which does not, however, include insulation testing. Indeed, such testing has been rather within the activities of the classification societies. It is possible that the American Bureau of Shipping could be helpful. Again, the Commercial Refrigerator Manufacturers Association, as a group developing and promulgating standards for testing commercial refrigerators might have suggestions, too.


FOR COOL HORSEPOWER IN ALL KINDS OF AIR MOVING REQUIREMENTS:
TORRINGTON HAS ANALYZED THE INPUT TO OUTPUT EFFICIENCY CORRELATION IN THOUSANDS OF DIVERSIFIED APPLICATIONS OF AIR MOVING COMPONENTS
FROM THE HEAVY-TONNAGE SPECIFICATIONS FOR HEATING, VENTILATING AND AIR CONDITIONING PRODUCTS TO THE ULTRA-PRECISE COOLING REQUIREMENTS OF SPACE-AGE ELECTRONICS EQUIPMENT.
THAT'S WHY ENGINEERS TOSS THEIR AIR MOVING PROBLEMS TO TORRINGTON!
THE TORRINGTON MANUFACTURING COMPANY
TORRINGTON, CONNECTICUT • VAN NUYS, CALIFORNIA • OAKVILLE, ONTARIO

New industry standards

A. T. BOGGS, III
ASHRAE Technical Secretary

Plastics approved: The State of Illinois recently approved use of plastics pipe and fittings for certain applications set forth in its new Plumbing Code. This marks official acceptance by Illinois of plastics pipe and fittings for house or building service connections for drainage and vent piping within buildings and in cold water piping systems outside building walls or foundations. Other states that have approved use of plastics pipe for varied water services are California, Kentucky, Maine, and Wisconsin. In Illinois, plastic pipe must carry the National Sanitation Foundation seal of approval to comply with the new Illinois Code. For additional information contact Plastic Pipe Research Council, The Society of the Plastics Industry, 250 Park Avenue, New York 17.

Plumbing Code: ASA Sectional Committee A40, Minimum Requirements for Plumbing, is being reorganized to review the draft of a proposed revision of the National Plumbing Code A40.9-1955. The draft revision is being prepared by the U. S. Public Health Service Technical Committee on Plumbing Standards.

Nema Standards: The following Nema standards publications are available. Copies may be obtained from Nema headquarters (155 East 44th Street, New York, N. Y.).

DC 4-1959—Dial Arrangement of Warm Air Limit and Fan Control: The operating range, differential, dial stop and shipping setting for dial arrangement of warm air limit and fan controls are given. 20c per copy.

HE 2-1959—Electric House Heating Equipment: This standards publication covers definitions, ratings, markings, methods of test, performance, safety and durability of electric space heating equipment of the types principally used in residences, such as baseboard heaters, wall heaters and heating cable. 30c per copy.

Gas-fired air conditioners: The ASA Sectional Committee Z-21 (AGA Approval Requirements Committee) has developed a new American Standard to cover gas-fired air conditioning equipment. Effective as of July 1, 1959, the new standard is published under the designation Z21.40-1959, American Standard Approval Requirements for Gas-Fired Absorption Summer Air Conditioning Appliances. The requirements represent basic standards for safe operation, substantial and durable construction, and acceptable performance.

Plastics piping approved in Illinois

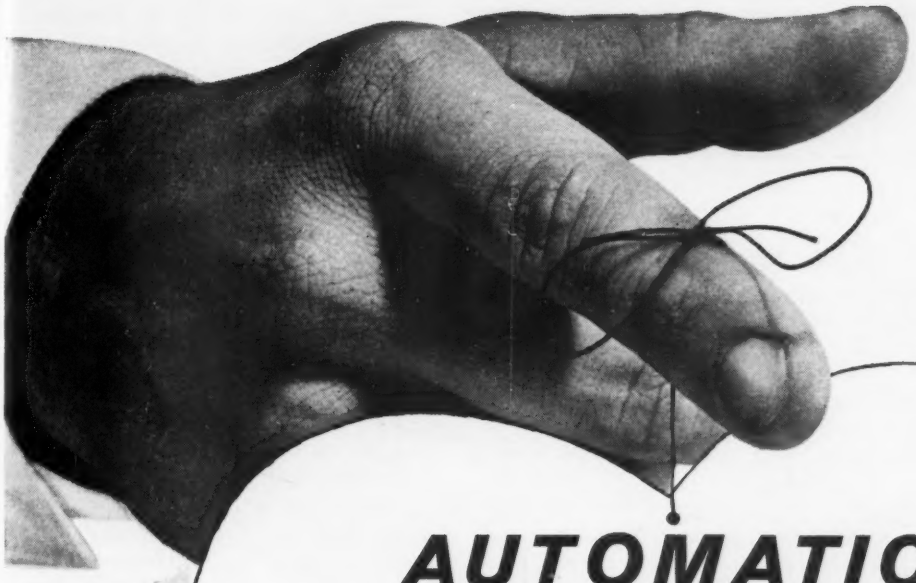
ASA has gas-fired air conditioner standard

ARI rates centrifugal liquid chillers

Welding symbols: ASA has approved the latest revision of the American Standard Graphical Symbols for Welding. The symbols were developed by the American Welding Society and approved by ASA Sectional Committee Y32, sponsored jointly by ASME and AIEE. Designated Y32.2-1959, the new standard provides means of placing complete welding information on drawings. Copies are available at $3 each from ASA or ASME.

Centrifugal liquid chillers: ARI Standard 550-59, Centrifugal Liquid-Chilling Packages is now available for distribution. The new standard defines a centrifugal liquid chilling package as a: "factory-designed and prefabricated assembly (not necessarily shipped as one package) of one or more centrifugal compressors, condensers, and liquid coolers, with interconnections and accessories. The standard applies to equipment using both open and hermetic centrifugal compressors. Copies of the standard may be obtained from ARI at 40c each.

Instrument Society of America: ISA-RP 1.1-1.7 Thermocouples and Thermocouple Extension Wires has been issued recently by ISA. The purpose of this recommended practice is to establish uniformity in the designation of various types of thermocouples and extension wires. It provides color coding, terminology, limits of error, wire sizes, fabrication, installation and application, and temperature-electromotive force tables. Another new publication, RP 16.1.2.3 on Variable Area Meters has been issued by ISA. This recommended practice covers terminology, dimensions and safety practices for indicating glass, metal, and extension type glass tube variable area meters (rotameters). Copies of these publications are available from ISA headquarters, Pittsburgh 22, Pa.

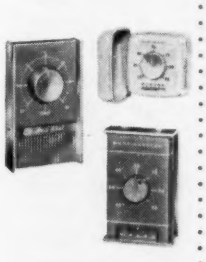


AUTOMATIC CONTROL

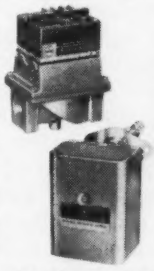
If automatic control is the heart of your product's performance, it will pay you to rely on "controls specialists." At White-Rodgers, controls are our only business . . . built to assure accurate performance for the life of your equipment.

When you're ready to talk over your control requirements, White-Rodgers application engineers are at your service . . . they're controls specialists.

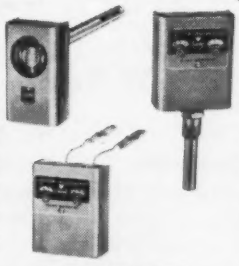
Write, wire or phone.



THERMOSTATS

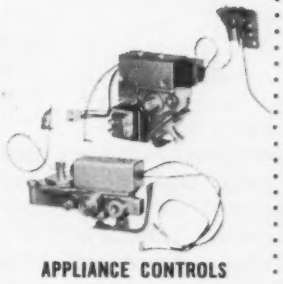


OIL & GAS HEAT CONTROLS

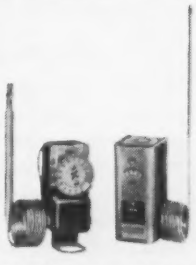


WARM AIR & HOT WATER CONTROLS

ZONE CONTROLS



APPLIANCE CONTROLS



REFRIG. & AIR-COND. CONTROLS

WHITE-RODGERS

ST. LOUIS 6, MISSOURI
1209 Cass Avenue

TORONTO 8, CANADA
611 Gerrard St. East

231

BULLETINS and CATALOGS

Roller Bearings. Featuring a one-piece cage design, HJ Series roller bearings are described in detail in 6-page Catalog 359. Utilizing a cage bar depressed within the roller pitch circle, the cage design permits use of these bearings at speeds cited as being higher than is possible with conventional full complement roller bearings. Boundary dimensions of this series conform to AFBMA Series NAA and NAB and the bearings are interchangeable with needle bearings made to these standard in.-size dimensions. Bore sizes range from three-quarter to four-in.
Torrington Company, Torrington, Conn.

Electrical and Lubricating Devices. Twelve pages of descriptive data covering types and usage of these devices are provided by Catalog 59. Newly developed products are included and all items listed with catalog numbers, capacities and sizes.
Trico Fuse Manufacturing Company, 2948 N. 5th St., Milwaukee 12, Wisc.

Heaters and Blower Assemblies. Outlined in two 4-page bulletins, GU-100 for gas-fired unit heaters and GD-100 for gas-fired duct heaters and blower assemblies, are construction features, specifications, ratings and performance data.
L. J. Wing Manufacturing Company, Div of Aero Supply Manufacturing Company, Inc., Linden, N. J.

Industrial Controls. Combining information from several of this company's other catalogs to present a comprehensive line, this bulletin lists many products, including automatic temperature, pressure, level and flow controls, as well as counters, switches and automation controls. Other items described and illustrated are industrial actuators, combustion instrument controls and controller and pressure indicators.
General Controls Company, 801 Allen Ave., Glendale 1, Calif.

Automatic Firing Equipment. Twelve-page Catalog 6260, showing a complete line of fuel burning and auxiliary equipment, contains an "Index and Selection Chart" which aids selection of appropriate equipment for various applications. Oil burners, gas burners, dual-fuel burners for gas and oil, forced draft package units, boiler-burner units, coal stokers, factory-wired combustion control panels and a steam heating system are included. One section discusses the selection of fuels and types of draft available.
Iron Fireman Manufacturing Company, 3170 W. 106th St., Cleveland 11, Ohio.

Insulating Flange Assemblies. Furnished to the user's specifications, insulating flanges aid in combatting electrochemical or galvanic corrosion of underground piping installations. Difficult field assembly of such joints spurred development of package components, ready for installation in the line. Details are given in 4-page Bulletin 359.
Tube Turns, Div of Chemetron Corporation, Louisville 1, Ky.

Dust Collectors. Self-contained cabinet cloth filter-type dust collectors are the subject of 6-page Bulletin 359, which contains cuts of all models available. Units range from 160 to 2000 cfm in capacity. Also included are centrifugal cyclone separators, ranging from 250 to 6500 cfm.
Torit Manufacturing Company, St. Paul 16, Minn.

Portable Phase Sequence Indicator. Offered by this manufacturer is Bulletin 7-1.1, descriptive of a pocket portable instrument for indicating phase sequence in three-phase power systems. Model 40 is for 60 cycle power and has a switch for adjustment to 120, 240 and 480 volt.
Associated Research, Inc., 3777 W. Belmont Ave., Chicago 18, Ill.

Hydraulic Hose and Assemblies. An every-day guide for hydraulic hose users, this 16-page catalog outlines low to high pressure hose specifications. Detailed thread and fitting information is included for both the permanent and re-useable types of couplings. Making available complete assemblies, Hydra-Flex Hydraulic Hose Assemblies are also covered.
Hydraulics, Inc., 40 Lafayette St., Newark 2, N. J.

Insulation of Trucks. Detailed information on insulation of refrigerated truck bodies and trailers as well as air conditioned vehicles is provided in a 12-page booklet. A problem cited as having existed for years is the increased weight and loss of insulation efficiency through air infiltration and moisture accumulation. Dealt with in the bulletin are methods of eliminating this problem, the use of air barrier treatment and general considerations in insulating refrigerated trucks.
Armstrong Cork Company, Lancaster, Penna.

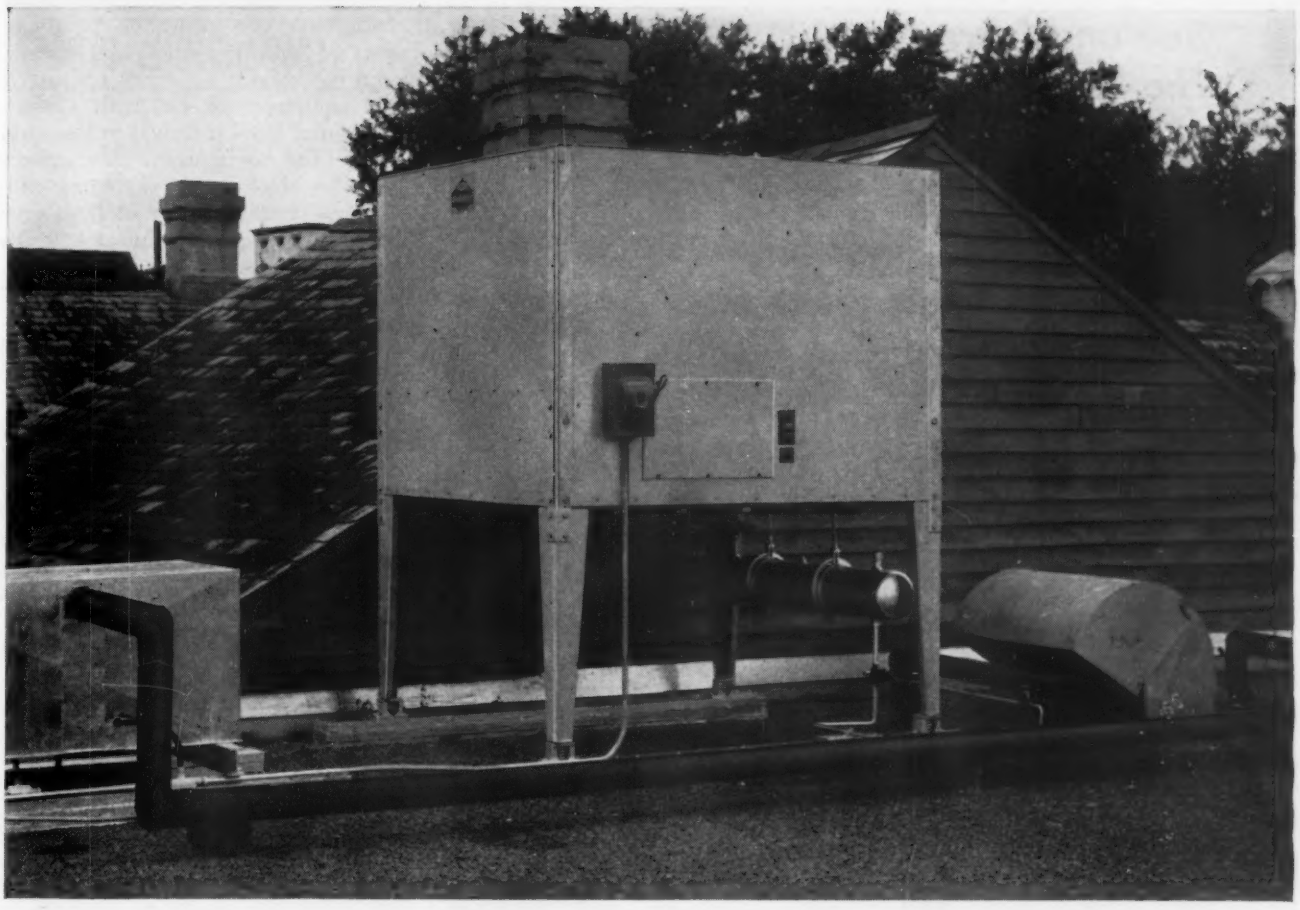
Roof Ventilators. Gravity exhaust ventilators, a curb-mounted fan, exhaust boosters (motor-operated) and continuous ridge ventilators are the subject of 12-page Bulletin 59. Complete data on all models in the line is included.
Western Engineering and Manufacturing Company, 4114 Glencoe Ave., Venice, Calif.

Electric Heating Units. Of slab, tube, shell and flexible types, Temp-O-Line high heat release units are resistant to chemical vapor, uni-directional, near or far infra-red, uniform with no hot spots, chemically inert, self-cleaning and shock resistant. Four-page Bulletin 7-59 contains ratings and product descriptions.
Beltran Associates, Inc., 1133 E. 35th St., Brooklyn 10, N. Y.

Dryers and Filters. Six-page Bulletin R-34, Compressed Air and Gas Dryers; Flyer R-35, Prefilters for Compressed Air and Gas Systems; and Flyer R-36, Control and Instrument Air Dryers, cover this manufacturer's line. Uses, operation, design features and capacity tables for all models are included.
Desomatic Products, Inc., 1109 W. Broad St., Falls Church, Va.

Induced Draft Cooling Towers. Explained in 4-page Bulletin KT-104 are construction, specifications and performance details for these cooling towers, which have a centrifugal-type fan for quiet indoor or outdoor operation. Special attention is given to the fan, fan motor, mounting base and V-belt drive, formed eliminators, wetted deck surface and one-piece welded sump pan.
American Air Filter Company, Inc., 215 Central Ave., Louisville 8, Ky.

Inspection Light and View Ports. Heat-resistant, pressure-tight and dust-proof, the units described in this bulletin are cited as providing excellent visibility for observation of chemical reactions, combustion and other processing operations within equipment such as ovens, dryers and de-



Marley DRICOOLER®

AIR COOLED REFRIGERANT CONDENSER

gives a new look in the "OLD QUARTER"

Even amidst the old-world charm of New Orleans' French Quarter, clients are quick to accept change that results in improved efficiency and increased profits. That's why the engineer for a store in the Vieux Carré was among the first to specify and install Marley's new DriCooler to handle the cooling requirements for air conditioning and refrigeration.

In Marley's complete new series of air cooled refrigerant condensers, you'll find *more* of everything you want—performance, durability, economy. DriCoolers are conservatively rated to insure full-capability performance, built to insure lasting performance. Dependability and durability are apparent in the heavy-duty, industrial-type mechanical equipment, and in extra-rugged structurals and casings that are hot-dip galvanized for maximum corrosion resistance. Design innovations have significantly lessened maintenance and refrigerant costs. Operational noise has been minimized.

You're on solid ground when you specify DriCoolers, for they are backed by Marley's world of experience in air cooled heat exchange, and by the company's single-responsibility guarantee. For complete information on the 9 models available for all-season service, in capacities from 15-100 tons nominal, call your nearby Marley engineer or write today.

THE MARLEY COMPANY MARLEY KANSAS CITY, MISSOURI

See and learn about
The Newest Products
at the

2nd Southwest

HEATING & AIR-CONDITIONING EXPOSITION

(under the auspices of ASHRAE)

Dallas, Texas · Feb. 1-4, 1960

Memorial Auditorium

Held in conjunction with the semi-annual meeting of the American Society of Heating, Refrigerating and Air-Conditioning Engineers, this important exposition will bring an unprecedented concentration of technical information to Dallas . . . vital information you'll need to keep abreast of the changes and developments affecting your day-to-day operations.

SEE more than 200 informative displays covering recent progress in air handling and treating equipment as well as refrigeration.

MEET more than 1000 technical representatives of the leading manufacturers in your industry.

DISCUSS with them how their new products can lead to bigger profits for you.

COMPARE and judge at first-hand the relative merits of competitive products.

DECIDE which of them can best suit your needs. 2211

2nd Southwest

HEATING & AIR-CONDITIONING EXPOSITION

Management: International Exposition Company, Inc.
480 Lexington Ave., New York 17, N. Y.

hydrators. The inspection light consists of a heavy-duty globe inserted into the outside casing or housing of the equipment in use, with a vibration-proof lamp attached to the inner side of the casing and to an aluminum or alloy steel frame. Features cited include impermeability of both units to corrosive liquids or fumes and ease of changing bulbs from outside without interference with equipment operation.
Robert H. Wager Company, 423 Valley St., South Orange, N. J.

Air Handling Units. Designed and fabricated for special applications, these units are available in 2, 3, 5 and 7½-ton sizes and include a direct expansion cooling coil. They may be furnished with a single or double row reheat coil. An illustrated flyer fully describes the units.
Rempe Company, 340 N. Sacramento Blvd., Chicago 12, Ill.

Sewage Plant Effluent. Sixteen-page Technical Paper No. 138 reports on how sewage plant effluent can satisfactorily be used in recirculating cooling systems and as boiler makeup provided it is adequately treated to avoid operating problems such as organic growths, deposits and corrosion in cooling systems, and foaming, carryover and ammonia corrosion in boiler and steam systems.
Betz Laboratories, Inc., Gillingham & Worth Sts., Philadelphia 24, Pa.

Pillow Blocks. Featured on these pillow blocks, described in 4-page Catalog Bu-102-A, are unbreakable malleable housing, tapered roller bearing, eccentric locking collar, labyrinth grease seals and elongated bolt holes.
Browning Manufacturing Company, Maysville, Ky.

Motor Start and Run Capacitors. Complete listings of dry electrolytic ac motor starting capacitors and oil impregnated ac continuous duty capacitors are contained in 8-page Catalog 9-177, which also includes information on selection and testing of these units. A feature of the bulletin is a replacement part cross reference.
P. R. Mallory & Company, Inc., P. O. Box 1885, Indianapolis 6, Ind.

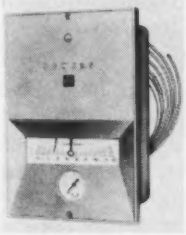
Reference Chart. 136 air conditioning products and 49 gas and oil-fired furnaces are listed on this chart, which shows this manufacturer's full line. Designed for easy reference in determining the availability of a unit to meet the specifications of a par-

(Continued on page 102)

PARTS AND PRODUCTS

SUBMASTER REGULATOR

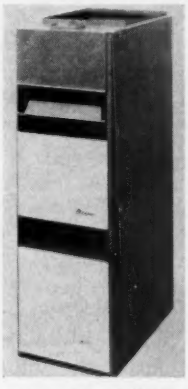
Typical applications of the Series 200 Regulator are: fan discharge control, remote process control, hot water zone supply and dewpoint control. A pneumatically operated temperature controller, whose control point is reset by a master controller or positioning switch, the instrument has a throttling range adjustment of zero to 35%. The master may be a thermostat, hygrostat, pressure regulator or a manual positioning switch. Unaffected by cross ambient bulb and capillary temperatures, the gas-filled thermal system also eliminates the need for bulb elevation correction.



Powers Regulator Company, 3434 Oakton St., Skokie, Ill.

FORCED AIR FURNACES

Utilization of direct drive blowers in the full range of sizes provides a furnace only 51 in. high, making it easily adaptable to basement installations, with optional return duct cabinet. Other features of the Pacemaker line include a large drive blower for more air volumes at lower speeds than in other lines and an optional blower for higher capacity air delivery requirements.



Payne Company, P. O. Box 2222, La Puente, Calif.

1960 LINE

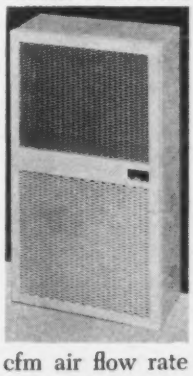
High capacity room air conditioners and versatile heat pumps are featured among the more than 100 models that comprise this manufacturer's 1960 line. Included are a one hp model with a capacity of 13,500 Btu/hr and the Super Custom Model 2390C which develops 23,900 Btu/hr. Some 50 models of residential-commercial air conditioner equipment, ranging in capacity from two through 15-ton are offered with a wide selection of evaporators for use with furnaces, in addition to an assortment of evaporator blower units in capacities of two through 20-ton for both free discharge air applications or with ducts.

Included in the heat pump line are 45 basic models, many with evaporator-blowers for cooling applications. These range in capacity from two through five ton in a one-piece design, and in 15 and 20-ton units comprised of a completed assembly of three modules.

Mathes Company, Div of Glen Alden Corporation, Fort Worth, Tex.

FAN-COIL UNIT

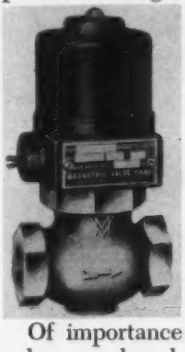
Providing all-season air conditioning with hydronic systems for residential and commercial applications, the Spotaire VRS fan-coil unit shown features a three-speed push button individual room control and an optional Adjacent Room Supply, permitting conditioning of two small rooms with a single unit. Two sizes are furnished, Model VRS-2-150 with a rated nominal capacity ranging from 2500 to 5500 Btu/hr with a 150 cfm air flow rate and Model VRS-2-300 at double the capacity of the smaller unit.



National-U. S. Radiator Corporation, 944 Ash St., Johnstown, Pa.

NORMALLY CLOSED VALVE

For use in applications where line pressure ratings are as great as 500 psi and where fluid temperatures do not exceed 400 F (and fluid is free from sediment and non-injurious to bronze), is the Type L full port, normally closed, solenoid operated valve.



Of importance is the fact that the valve can be cleaned and the operating mechanism replaced without removal of the valve body from the pipe line, by decoupling the hermetically-sealed solenoid cup and lifting out the entire operating mechanism.

Magnatrol Valve Corporation, Hawthorne, N. J.

MULTI-SHIELDED MOTORS

Application of standard drip-proof motors has been extended to include operation under adverse conditions of continuous and excessive moisture, high humidity and temperature, salt spray, dust, oil and chemically contaminated atmospheres that previously required totally enclosed fan-cooled protection.

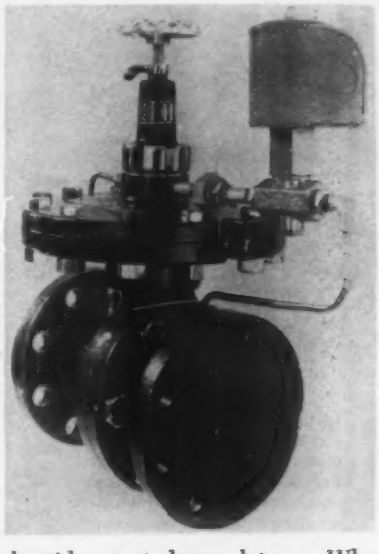
Multiple application and controlled processing of a special silicone sealing compound produce an insulation that is thin, non-porous, yet resilient and flexible, and will not chip, crack, peel or separate under extreme temperature. Other features are: herringbone rotor design for quiet operation, completely sealed bearings, terminal box sealed with a neoprene gasket and diaphragm seal and neoprene insulated lead wires.

Motors are available in all ratings from ½ to 50 hp, any phase, frequency or voltage, torque or slip characteristics, and with multi-speed winding. Special duty motors are also available.

Sterling Electric Motors, 5401 Telegraph Rd., Los Angeles 22, Calif.

REGULATORS

Used in industry wherever remote shut-off, remote start-up, automatic safety shut-off and combination pressure and temperature control with an electric signal are needed, are these



solenoid-actuated regulators. When the solenoid opens, it allows steam to enter the pilot chamber and operate the main valve as a normal pressure regulator, but when it closes, the steam supply to the pilot is shut off and the main valve closes automatically.

Available in ductile iron for one-half to three in., in bronze for one-half to two in. and in cast iron for two and one-half to three in., regulators are suitable for maximum temperatures of 500 F and pressures of 250 psi.

OPW-Jordan, 6013 Wiehe Rd., Cincinnati 13, Ohio.

ticular job, the chart includes such equipment as ceiling-mounted water-cooled units of 5 and 7½-ton capacity, water-cooled self-contained units in 13 sizes ranging from 3 to 75-ton, water-to-air heat pumps in capacities from 2 to 45-ton and air-to-air split systems of 3 to 30-ton capacity.
Typhoon Air Conditioning Div, Hupp Corporation, 505 Carroll St., Brooklyn 15, N. Y.

Circuit Breaker Accessories. Providing all information necessary to select, specify and order these items, 12-page Bulletin GEA-6757 describes this manufacturer's complete line of industrial molded case circuit breaker accessories and modifications.
General Electric Company, 90 Whiting St., Plainville, Conn.

Unit Heaters. Details of this new line for both steam and hot water are described in 12-page Bulletin 1301B, containing steam and hot water capacity data, conversion factors and basic formulae, typical quietness levels and piping arrangements. Construction features include individually adjustable horizontal and vertical louvers, improved header design, double duty hanger supports, totally enclosed motor, fan guard, resilient motor mounting and slow-speed fan in Type H horizontal discharge heaters. Featured in the vertical discharge models, Type C, are a spun steel top and bottom, open frame motor and a motor support cone that directs air from heating element to fan and protects motor from heat and dust.
Dunham-Bush, Inc., West Hartford 10, Conn.

Electronic-Pneumatic Transmitter. Combining the advantages of electronic sensing and pneumatic actuation in a transistorized controller, Model R07903 gives control of temperature in central fan systems. Four-page Bulletin 76-8147 gives information on this controller, describing main features and illustrating sensing elements.
Minneapolis-Honeywell Regulator Company, 2747 Fourth Ave. S., Minneapolis 8, Minn.

Prevention of Moisture and Corrosion Damage. Designated CRC 2-26, this liquid formula has been especially developed for manufacturing and maintenance use in the electrical and electronic equipment fields. An inhibitor that displaces and seals out moisture, protects metal surfaces against corrosion and lubricates, it is described in a six-page folder.
Corrosion Reaction Consultants, Inc., 116 Chestnut St., Philadelphia 6, Pa.

Stainless Steel Products. An extensive compilation of more than 500 consumer products made in stainless steel and the names of the firms that manufacture them, is this 88-page booklet, "Buyer's Guide for Stainless Steel Consumer Products." Divided into six categories, it covers items in the automotive, hardware, home building, home furnishings, personal and recreation fields. All products are listed alphabetically within the categories and sub-divisions as well as in the complete index at the end of the book. Two introductory sections, "Advantages of Stainless Steel Products" and "History and Mystery of Stainless Steel," specify benefits of these products and outline the metal's evolution and technology.
Union Carbide Metals Company, Div of Union Carbide Corporation, 30 E. 42nd St., New York, N. Y.

Refrigeration and Air Conditioning Controls. Outlining the newest control developments for these industries, 6-page Bulletin SP-12 contains brief data on hermetically sealed overheat protectors for single and three-phase

Read Superheat the MARSH way—

—It's the sure way—the easy way

...and it costs less!

Serviceman
"Super-Heat" Kit

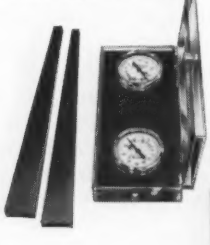
Contains two attractive, polished brass, 2½-inch thermometers, graduated —40° to +65° F. Also two insulating wrappers for easy bulb attachment and to insulate bulbs from ambient temperature (vital to testing accuracy). Thermometers, wrappers and manuals compactly held in durable 3" x 8" x 1¼" box with handy hinged cover. Moderately priced thanks to efficient production.

Your setting of the expansion valve can be no more accurate than your reading of superheat. How do you read it?

The Marsh way is the accurate way...the lowest cost way, too, when you compare these long-lived thermometers with the breakable glass tube kind.

Instead of those hard-to-read, hard-to-use glass tube thermometers, a handsome pair of distant reading dial thermometers with small bulbs easy to attach at exactly the right place. Widely spaced markings in working area assure far greater reading accuracy than is possible with glass tube thermometers... guaranteed accurate within one division plus or minus.

Put the bulbs where they belong; the dials where they can be seen and compared...and you're "in business." Manual in every kit tells how to get best results. Write for facts or



See Your Wholesaler
MARSH INSTRUMENT COMPANY, Dept. 32, Skokie, Ill.
Division of Colorado Oil and Gas Corporation
Marsh Instrument & Valve Co., (Canada) Ltd., 8407 103rd St., Edmonton, Alberta. Houston Branch Plant, 1121 Rothwell St., Sect. 15, Houston, Texas.

MARSH *Refrigeration Instruments*

COPPER TUBE

creates confidence in YOU!

"COPPER TUBE...nothing else is 'just as good'"

says the manufacturer

Copper tube lends itself to all fabricating procedures ...in the plant or on the job site. Copper tube is easy to bend, flare and form. And it's just about the most 'joinable' tube you can get. Ideal for soldering, brazing or welding—not only copper to copper, but copper to other metals, too.

Often overlooked, but certainly one of copper tube's most important advantages, is its ability to make a product or an installation *more saleable*. The reputation for quality earned by copper tube through years of dependable service is a vital asset to the product you make or the job you do.

For refrigeration lines, air conditioning coolant lines, bottled gas lines and special applications... order copper refrigeration tube, sealed at the factory to keep it clean and dry. Your supplier also has a complete line of copper water tube for water lines and other applications. Whatever the use... you can rely on copper tube to do the job *right!*

Look for "Made in U.S.A." on all copper tube. The manufacturer's brand name and this symbol also are used by many U.S. copper and brass mills to designate tube products that meet the exacting standards of American industry.

MADE IN U.S.A.
TO THE STANDARDS
OF AMERICAN INDUSTRY

Specify Copper Tube for Air Conditioning and Refrigeration

COPPER & BRASS RESEARCH ASSOCIATION • 420 LEXINGTON AVE., NEW YORK 17, N. Y.

compressor motors, hermetically sealed thermostats for compressor motor winding use and supplementary overloads for line current sensing. Information on thermal and current-type compressor motor starting relays, a new series of commercial thermostats for operating and limit applications and "Star Series" motor protector and motor starting relay kits for complete replacement service on domestic refrigeration is also included.
Texas Instruments Inc., Metals & Controls Div., 34 Forest St., Attleboro, Mass.

Valves and Accessories. Containing in its 12 pages information on high pressure line filters, unloading valves, high pressure check valves, relief valves and velocity fuses, Catalog 3000 illustrates each item and presents dimensions, description, adjustable pressure range and typical applications.
Waterman Engineering Company, 725 Custer Ave., Evanston, Ill.

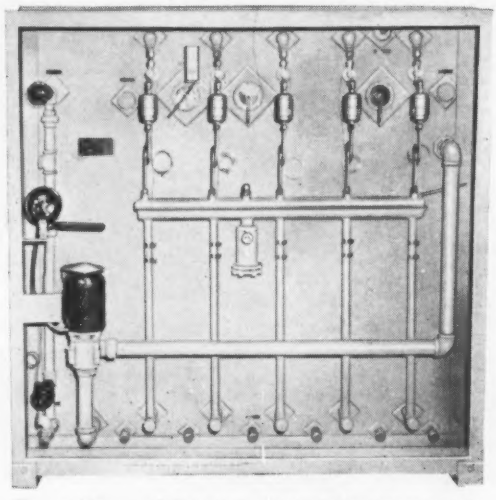
Dampers. Designed so that it can either be hung on a wall or used in a loose-leaf binder, this chart, "How to Make Dampers," gives step-by-step instructions for constructing multi-blade dampers of both parallel and opposed action. A check list showing every item required for the production of these units indicates the quantities of the various parts required and contains data for the needed material, including gauges and measurements.
Duro Dyne Corporation, Farmingdale, N. Y.

Heaters, Furnaces and Packaged Blowers. Enabling the reader to select heaters and furnaces according to type, applications, capacities and major features is an illustrated two-page table of contents in 28-page Catalog SA-5900. Separate inside sections give detailed descriptions of this manufacturer's fan- and blower-type unit heaters, five-way air flow heaters, heavy duty units, duct and forced air furnaces, blower packages and a motorized vent exhauster. Complete specifications, dimensional and per-

STEP AHEAD with "King Zeero's" NEW Combination PURE WATER COOLER and ICE BUILDER

For INGREDIENT and WASH WATER APPLICATIONS

Provides a Clear Odorless, Palatable, Cold Water Supply



Front View of PURE WATER COOLER (P. W. C.) installed at Salerno-Megowen's large new baking plant at Niles, Illinois.

Equipped with self-contained activated carbon filter, which removes silt, algae and chlorine from city or well water supply. Cools water to 34 degrees Fahrenheit. Pure water is chilled by ice water - prevents freeze-ups. The ideal water for food processing needs, butter or cheese wash, dough water, poultry or produce chilling. or any application where good, cold, clean water is required. Can be connected to present refrigerating machines using ammonia, freon, or methyl-chloride.

The Ice Builder side of the unit may be connected to secondary equipment designed for ice water cooling such as milk coolers, tanks, dough mixers, or air conditioning equipment.

Write for Bulletin PWC 59.

THE KING ZEERO COMPANY 4300-14 W. Montrose Ave. Chicago 41, Ill.

Manufacturers of Ice Builders - Ice Builder Cabinets - Ice Banks Pure Water Coolers

TECHNICAL COMMITTEE

(*Continued from page* 82)

to the Research and Technical Committee is the Panel on Food Refrigeration and Food Technology recently formed under the Chairmanship of W. T. Pentzer. The place of food technology and refrigeration in the structure of our Society needs thorough review and through the deliberations of this Committee the Research and Technical Committee hopes to recommend to the Board of Directors and Council definitive action. A third Panel on Psychrometry and Psychrometric Charts has also been formed under the Chairmanship of John Everetts. The policies of the two societies in this area have been somewhat different and again it is the intent that definitive recommendations be forthcoming. Other panels will be formed as needed and whenever necessary personnel from outside the Society will be added to the Panels in order to provide breadth to the recommendations.

E. P. Palmatier, Vice-Chairman of the Research and Technical Committee, has accepted the assignment of coordinating the activities of the Technical Division of the Research and Technical Committee, and in a coming issue of the ASHRAE JOURNAL Vice Chairman Palmatier will elaborate upon the activities of the new Technical Groups and Technical Committees.

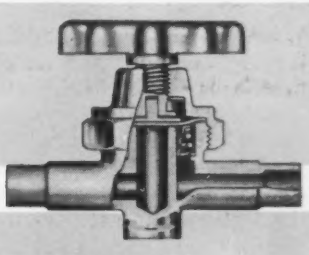
HENRY VALVE CO.

CONTROLLING FLOW SINCE 1914

Every product bearing the name Henry carries with it complete assurance of on-the-job satisfaction. This quality of performance and the confidence it inspires have made Henry the most accepted line in the industry.

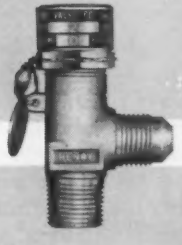
VALVES—Shut-off

Packless, Packed and Wing Cap Types



VALVES—Pressure Relief

Piston and Diaphragm Types

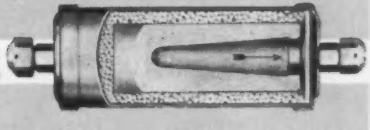


VALVES—Flow Check

Spring Loaded and Free Floating Types

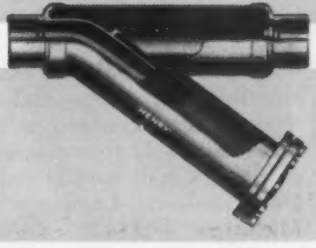
FILTER-DRIERS & Driers

Sealed and Cartridge Types



STRAINERS—All Types

Sealed and Cleanable



HENRY VALVE COMPANY

For Refrigeration, Air Conditioning and Industrial Applications

MELROSE PARK, ILLINOIS, U.S.A. CABLE: HEVALCO, MELROSE PARK, ILL.

formance data are included for each category with applications of each type discussed in special sections.
Reznor Manufacturing Company, Mercer, Pa.

Seals, Fasteners and Connectors. Complete tabular data, military and commercial specifications, brief descriptive text and engineering drawings are provided for high-pressure, vibration-resistant seals and fasteners and armored blade power connectors in 16-page Catalog 359A. Indexed for convenience of use, the bulletin has a page listing local engineering representatives.
A.P.M. Corporation, 252 Hawthorne Ave., Yonkers, N. Y.

Water Coolers. Free-standing, flush-to-wall, wall-hung and remote cooler models as shown in 4-page Bulletin A-374 feature a refrigeration principle known as packaged cooling. This term refers to the separate inside cabinet, a self-contained unit housing the entire refrigeration system.
Sunroc Corporation, Glen Riddle, Pa.

Rigid Polyvinyl Chloride. Characterized by high strength, wide range of corrosion resistance and ability to be fabricated and joined to itself by a variety of processes, this is cited as having become a major material of construction. Descriptive of this manufacturer's products using this synthetic, their properties and applications is a 24-page catalog.
Kaykor Industries, Inc., Div. of Kaye-Tex Manufacturing Corporation, Yardville, N. J.

Residential Evaporators. Physical and capacity data are detailed in Flyer 190 for this line. Designed to fit the majority of furnaces, the first four sizes of these evaporators are square, making possible mounting with access panel on any side of the furnace.
Bohn Aluminum and Brass Corporation, Betz Div, Danville, Ill.

Chemical Products. Listing the properties and uses of approximately 375 industrial, pharmaceutical and agricultural chemicals currently produced, this 44-page catalog includes both established products and developmental items. Featured in the 1959-1960 edition is an expanded section on plastics and coatings products.
Dow Chemical Company, Midland, Mich.

Copper. Tracing the history of the uses of this versatile metal from the time of prehistoric man through the days of the Roman Empire and into the present is 36-page Bulletin No. 15, identified as "Copper, the Cornerstone of Civilization". Some chapter headings are: copper bearing ores, mining, milling, smelting, refining, properties of copper and its alloys, fabrication, world production and consumption.
Copper & Brass Research Association, 420 Lexington Ave., New York 17, New York.

Hygrometric Catalog. Many pieces of moisture-detection, control and alarm equipment, complete systems and individual components whereby specialized systems can be built are described in a 69-page bulletin. Heart of these moisture-detection systems is an electric hygrometer sensing element having an inherent sensitivity of $\pm 0.15\%$ relative humidity.
American Instrument Company, Inc., 8030 Georgia Ave., Silver Spring, Md.

Boiler Gasket Leakage. Corrosion, improper installation, sizing of the handhole cap and exposure of the gasket fill to the boiler water are given as possible causes of boiler gasket leakage in 8-page Technical Paper No. 139. Suggestions for minimizing this problem are discussed.
Betz Laboratories, Inc., Gillingham & Worth Sts., Philadelphia 24, Pa.

Time Defrost Controls. Intended usage of the 600 Series controls described in Flyer 5945 is for defrosting systems that require a fan delay or drain period at the end of the defrost cycle. General specifications and suggested wiring diagrams are presented in the bulletin.
Paragon Electric Company, Two Rivers, Wisc.

Large Volume Water Heaters. Bulletin CH-650 contains, in its 28 pages, full information on this manufacturer's line of heating equipment. Specifications, illustrations of the various models, and descriptions are included, presented in seven sections: Copper Coil Heaters, Underfired Heaters, Tanks and Accessories, Sizing Data, Recovery Data, Piping Diagrams and Tank Hook-Ups, and Typical Installations.
Cleveland Heater Company, 2310 Superior Ave., Cleveland 14, Ohio.

Gearbelt Drives. Made in five pitches to handle a wide range of loads, speeds and applications, these drives are cited as combining the flexibility of belt drives with the advantages of chain and gear drives. They eliminate slippage, metal to metal contact, stretch and lubrication. Power is transmitted by positive engagement of belt teeth with pulley grooves as in chain drives, rather than by friction as in belt drives. Catalog GB-201-A, 60 pages.
Browning Manufacturing Company, Maysville, Ky.

Adhesives, Sealants, Alloys and Coatings. Included in the 40 pages of the Resiweld booklet is a product description and technical bulletin on each item in this manufacturer's standard line of products, plus suggested uses.
H. B. Fuller Company, 255 Eagle St., St. Paul 2, Minn.

Infra-Red Heating. Explained in 16-page Bulletin PE1-59-5-1 is this method of heating, with formulae and equations illustrating various methods of calculating infra-red requirements for industrial and commercial heating included. Twenty charts and reference tables supply further information.
Bettcher Manufacturing Corporation, 3106 W. 61st St., Cleveland, Ohio.

Thawing Machines. Included in the 1960 line are solid copper spring-loaded pipe clamps for positive connections to frozen pipes and units incorporating a fully enclosed disc-type thermostat cited as assuring automatic precalibrated protection against overload. Descriptive of this manufacturer's products is a flyer detailing specifications and features.
Trindl Products, Ltd., 1807-11 S. Clark St., Chicago 16, Ill.

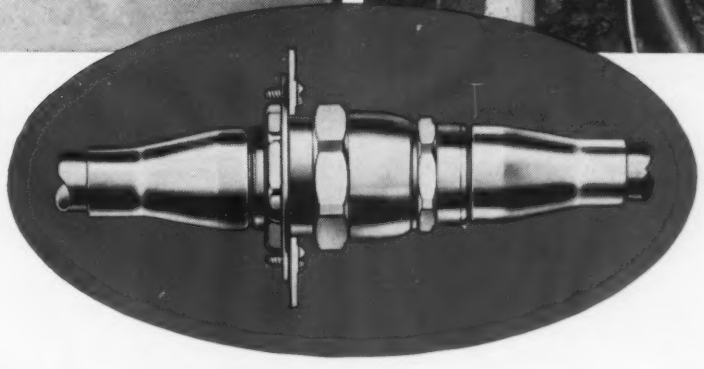
Metal Corrosion Prevention. Designated CRC 3-36, this liquid formula may be used both in metal manufacturing and maintenance, as a preventative of corrosion in many commonly-used metals. Explained in an 8-page bulletin are the methods of operation and application of the formula, its duration of effectiveness and details of its physical specifications.
Corrosion Reaction Consultants, Inc., 116 Chestnut St., Philadelphia 6, Pa.

Pipe and Electrical Markers. Manufactured of vinyl with pressure-sensitive backing, these markers offer permanent identification on pipes, cables, conductors, tubing, etc. Four-page Bulletin 803 gives a complete list of legends and colors available.
Seton Name Plate Company, 431 W. Rock Ave., New Haven 15, Conn.

Relay Control Amplifier. Particularly suited to instruments of laboratory accuracy as well as industrial process control and monitoring systems, the

Precharge and Field-Connect Refrigerant Systems with Aeroquip 5500 Self-Sealing Couplings

Precharged tubing is formed and fitted to meet each installation need. Note Self-Sealing Coupling halves on tubing have protective dust plugs to protect thread and valve.



Connection of precharged Lennox units to the tubing is quick and easy. There is no need to bleed and field charge the completed installation.

Aeroquip 5500 Series Self-Sealing Couplings are designed to meet requirements for refrigerant lines used in remote type refrigeration and air conditioning units. Factory-charged package units can be stored for long periods without leakage, then installed quickly, without bleeding and charging of the complete system.

Lennox is one of many equipment manufacturers who are users of the dependable 5500 Series Coupling on evaporator and condenser units.

The Aeroquip 5500 Series Self-Sealing Coupling features a leakproof design using only one mechanical joint. Each coupling half is brazed directly to tubing, eliminating adapters and screwed joints where leakage would be possible. Each coupling half seals tight until connected, preventing loss of refrigerant or inclusion of air into the system. As the coupling halves are joined by a hex union nut, the valves open to provide a full flow of refrigerant, with minimum pressure drop.

Aeroquip 5500 Series Self-Sealing Couplings are available in sizes to fit tubing from ¼" to 1⅛". Write for Bulletin IEB-32A for full details.

Listed by Underwriters' Laboratories, Inc.

Aeroquip

REG. TRADEMARK

AEROQUIP CORPORATION, JACKSON, MICHIGAN

INDUSTRIAL DIVISION, VAN WERT, OHIO • WESTERN DIVISION, BURBANK, CALIFORNIA

AEROQUIP (CANADA) LTD., TORONTO 19, ONTARIO

LOCAL REPRESENTATIVES IN PRINCIPAL CITIES IN U.S.A. AND ABROAD • AEROQUIP PRODUCTS ARE FULLY PROTECTED BY PATENTS IN U.S.A. AND ABROAD

You get a lot to like . . . from Calgon®!

Yes, for every water problem you may encounter, there is a Quality Calgon Product specially formulated to take care of it. Take a look at what Calgon has to offer—

1. MICROMET® PLATES—Easy-to-use, low in cost, one charge of Micromet Plates will protect most systems against scale and corrosion for six months.

2. CALGON SCALE REMOVER—To do an efficient job safely, use Calgon Scale Remover. This powdered acid has corrosion inhibitors, wetting agent, anti-foam and pH color indicator.

3. CALGON ALGAECIDE and CALGON BIOCIDE RP—These Algaecides kill slime and algae fast.

4. BANOX®—Protects condensers, pumps and water lines against corrosion. Use it at shut down—Spring start-up—after acid cleaning.

5. CALGON CONDENSER CLEANER—Specially formulated for low-cost, safe cleaning of cooling water systems.

Calgon products for *every* water problem include: Calgon Ice Machine Treatment, Ice Machine Cleaner and Gas Leak Detector. See your Refrigeration Wholesaler.

For free booklet on how to solve water problems, write:

CALGON COMPANY
HAGAN BUILDING, PITTSBURGH 30, PA.

DIVISION OF HAGAN CHEMICALS & CONTROLS, INC.

high-gain dc to ac relay control amplifier described in 4-page Bulletin 90 is cited as having stability of ± one micro-volt. Detailed information concerning principles of operation, performance ratings and applications for this vacuum tube amplifier are included.
Thermo Electric Company, Inc., Saddle Brook, N. J.

Temperature-Altitude, Temperature-Humidity and Temperature-Vibration Chambers. Representative units in this manufacturer's line of test chambers are shown in two bulletins of four and six pages, respectively, giving temperature ranges, interior size and construction details for each.
Conrad, Inc., Holland, Mich.

Disposable Odor Filter. Combining odor removal and air filtration, this disposable activated carbon filter can be used in almost any situation where contaminants in vapor form should be removed from an enclosed space. Four-page Bulletin No. 220 is descriptive of this product and includes engineering data.
American Air Filter Company, Inc., 215 Central Ave., Louisville 8, Ky.

Fluxes, Solders, Soldering Supplies. Products described and illustrated in 14-page Catalog C-1 include general purpose, stainless steel, aluminum, rosin and non-corrosive fluxes; paste solders; tinning compounds; silver brazing fluxes; aluminum and stainless steel solders; and soldering accessories.
Johnson Manufacturing Company, Inc., Mt. Vernon, N. Y.

Branch Connection Fittings. Covering cost comparisons, engineering design data, points of practical use and major benefits to the mechanical contractor, a 16-page booklet describes applications of the W-S Fishmouth branch connection fittings.
H. K. Porter Company, Inc., P. O. Box 95, Roselle, N. J.

Insulating Material. Uni-Crest, this organization's brand of expanded polystyrene insulating material, is discussed in an 8-page bulletin. Physical properties are listed, standard dimensions are given and thicknesses for a wide range of temperature conditions are recommended.
United Cork Companies, Uni-Crest Div., Kearny, N. J.

Fin-Tube Radiation. Baseboard units for residential, commercial, industrial and institutional heating are the subject of four-page Catalog 43R-4, which gives specifications, product cuts and description of accessories needed. Included is the Lino-ventilator, specially designed for classsroom heating and ventilating.
Vulcan Radiator Company, 775 Capitol Ave., Hartford 6, Conn.

Valves. Containing technical data, construction details, dimensions, materials, operating principles and information on placing orders, this booklet describes this manufacturer's lines of check, relief, shut-off, plug and custom valves.
Circle Seal Products Company, Inc., 2181 E. Foothill Blvd., Pasadena, Calif.

Activated Charcoal. "How Activated Charcoal 'Traps' Odors", a comprehensive article by a consulting engineer, is now available from this company. Included in the data presented are details on ability of charcoal to remove odors in specific areas.
Barnebey-Cheney Company, Cassady at 8th, Columbus 19, Ohio.

Blower Housings. Pre-engineered housings for blower wheels ranging from three through 11-in. diam are adaptable to any width single or double-inlet wheel. A 16-page catalog gives dimensional specifications and prices for all standard model housings and components.
Detroit Stamping Company, 340 Midland Ave., Detroit 3, Mich.

Level Transmitters. Pneumatic force-balance transmitters for measurement of level over range spans of one to 2000 in. water are covered in 4-page Product Specification P31-1. A simplified diagram illustrates operation of reset booster relay.
Bailey Meter Company, 1050 Ivanhoe Rd., Cleveland 10, Ohio.

Cooling Water Treatment. Covering the Dianodic method of corrosion control, this flyer tells how it has instituted changes in the treatment of open recirculating cooling water systems.
Betz Laboratories, Inc., Gillingham & Worth Sts., Philadelphia 24, Pa.

Brazing Alloys. Discussed in this 8-page bulletin are various high-purity brazing alloys for copper, bronze or brass. Given are complete specifications and cooling charts on standard alloy compositions for non-ferrous brazing, and similar data on silver solders for both ferrous and non-ferrous metals.
Alloy Specialties Company, Swissvale, Pa.

COMPLETE BANK MODERNIZATION JOB INCLUDES...

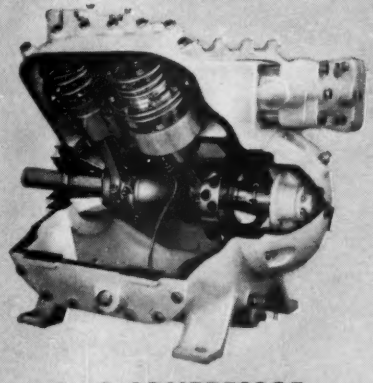
B&G PACKAGE LIQUID COOLER

In this "100% remodeling" of The State Exchange Bank, Culver, Indiana, the old bank was stripped down to its framework and completely rebuilt inside and out.

Remodeling included installation of a cooling system using a B&G Package Liquid Cooler, the advanced design unit that's completely new in conception.

Numerous features have been designed into this unit to make it more compact, more efficient and longer lived. It is equipped with B&G products throughout—the only unit of its kind with all major components designed, built and guaranteed by one manufacturer. Everything is included—there are no extras to buy. Thus costs which might otherwise be charged to the job are eliminated.

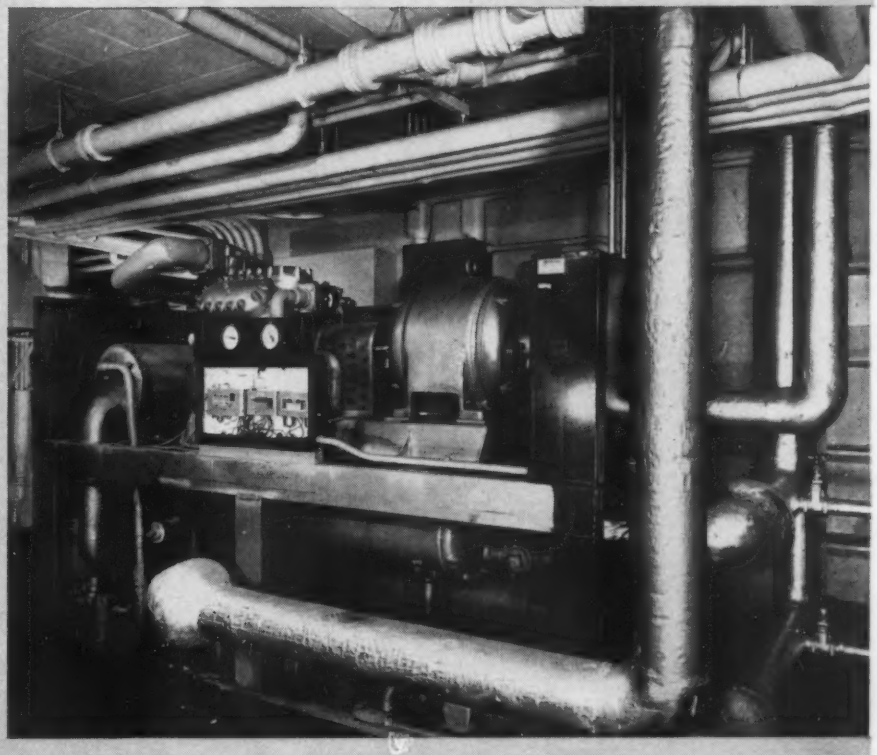
With all its advantages, the B&G Package Liquid Cooler is strictly competitive in price.



B&G COMPRESSOR

—a new unit to meet today's requirements

Like the Package Liquid Cooler this unit, too, is new in conception—not an adaptation of designs originated 20 years ago. Better design means fewer parts—and fewer maintenance problems. All units have *one* bore diameter—a few interchangeable parts will service them all. B&G Compressors can be equipped with multi-step capacity control systems.



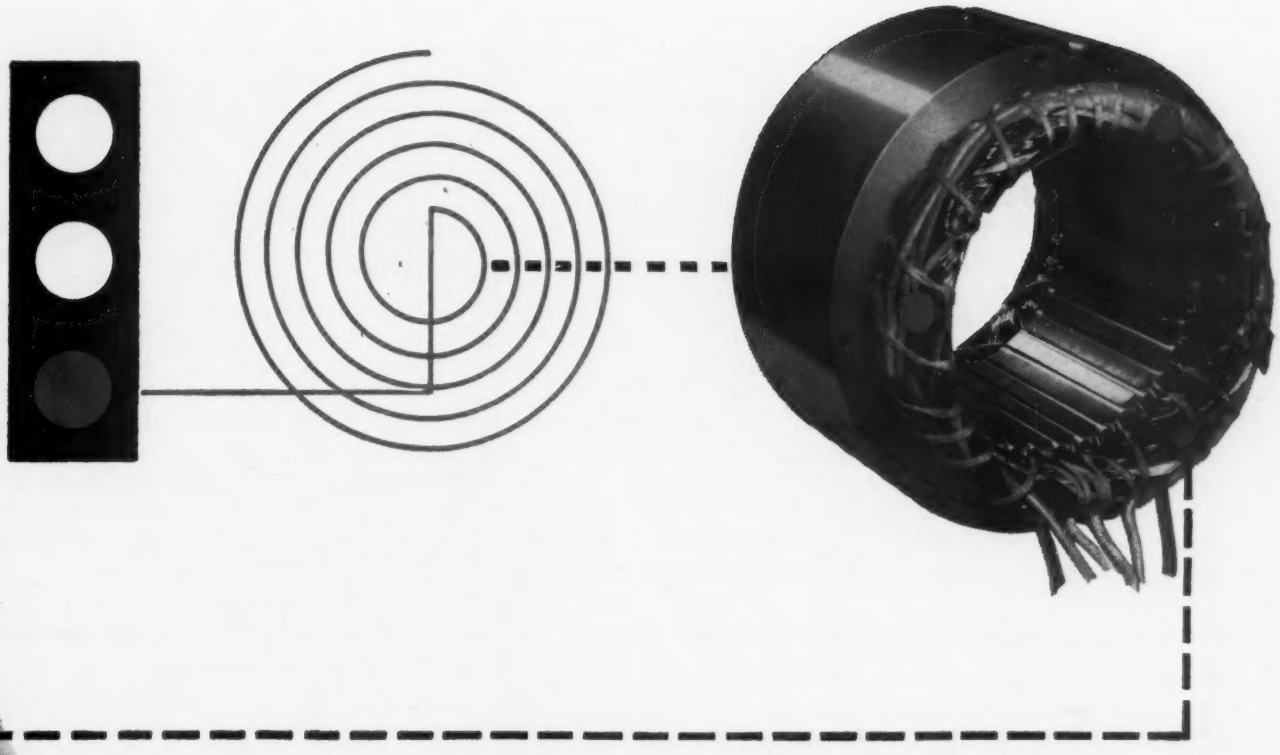
B&G Package Liquid Cooler installed in The State Exchange Bank, Culver, Indiana. This is a 40-ton capacity unit with a six-cylinder B&G Compressor. A B&G Series 1531 Centrifugal Pump circulates chilled water.

A FULL LINE OF REFRIGERATION AND AIR CONDITIONING COMPONENTS

BELL & GOSSETT COMPANY

Dept. GA-64, Morton Grove, Ill.

Canadian Licensee: S.A. Armstrong, Ltd., 1400 O'Connor Drive, Toronto 16, Ontario



New Westinghouse *Guardistor* motor stops motor failure caused by excess heat

At last, positive protection against motor overheating with this unique Westinghouse motor development. Smaller than an aspirin, the heart of the Guardistor* motor is a PTC† Thermistor embedded in the motor windings to sense temperature rise immediately.

With normal motor temperatures, the thermistor has low resistance which remains nearly constant up to a predetermined critical temperature. At this temperature, a 100 to 1 or more increase in resistance occurs for a small increase in temperature. The resistance stops current flow activating a control designed to "WARN" or "STOP" a motor failure.

The Guardistor motor and associated control integrates all heat-causing factors of load, ambient, and power supply right in the motor windings to give you complete protection against motor burn-out.

*Trade-Mark
†Positive Temperature Coefficient

J-22155-R

YOU CAN BE SURE...IF IT'S

Westinghouse

Watch Westinghouse Lucille Ball-Desi Arnaz Shows
CBS TV Alternate Fridays

THERMOELECTRIC DEVICE TO HEAT, COOL AND FREEZE

To be delivered to the U. S. Navy's Bureau of Ships by Westinghouse Electric Corporation is an experimental unit that will produce heat and cold without use of moving parts. Involved in this procedure is the passing of electricity through solid state materials, which become hot or cold depending upon the direction of the current flow.

CHILLED DRINKING WATER SYSTEM

Two Heat-X PCS 500-90 chillers, connected in parallel, supply 35 corridor bubblers with correctly cooled drinking water in Montreal's Northern Building. These chillers are basement installed, with final heat rejection to a cooling tower on the roof which serves various refrigeration purposes in the building.

MISSILES PRECONDITIONED

Large enough to accommodate a 28-ft missile, the "Thermobile," a mobile chamber designed and built by Lockheed Aircraft Corporation to precondition solid propellant missiles, is capable of lowering the temperature to –50 F for a rocket motor stored inside, with outside temperatures as high as 110 F, and can produce temperatures of 150 F with an outside temperature of –10 F. In this manner, test missiles can be calibrated for more accurate use in temperatures ranging from Arctic to Equatorial.

Of the cascade type, the system, equipment for which was provided by Dunham-Bush, uses Refrigerants 12 and 22. Two Brunner R5002 compressors, one EF500M5 (5 hp) and one E750M5 (7½ hp) compressor unit are the integral parts of the lowside equipment. A Heat-X inner-fin chiller is used in the evaporator-condenser portion and a ten-ton air-cooled blower condenser is mounted in the machine compartment. Shafts extend from this compartment through the insulated wall into the conditioned area where they drive the fans in the evaporator coils. Electric heaters are used for defrosting the finned coil and as the heat source when the system is run on the heat cycle.

WAREHOUSE INSULATED FOR LILY BULB STORAGE

Faced with the problem of refrigerating an existing frame warehouse for lily bulb storage, Knouse Flowers, Inc., of Stuart, Fla., made the conversion by using a water-repellent vermiculite fill insulation.

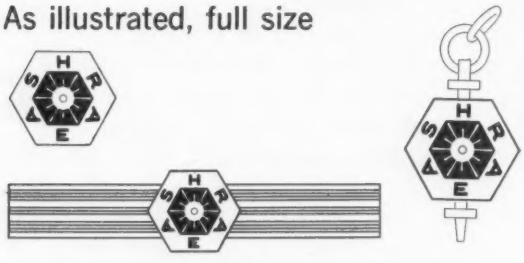
Eight-in. wood frame cavity walls constructed in 4 x 8-ft sections were filled with the insulating material, a development of Zonolite Company, and transported to the site. They then were erected inside the existing warehouse upon a six-in. concrete floor, previously poured and insulated.

CUT OUT ALONG THIS LINE AND SEND CLIPPING WITH CHECK

ASHRAE EMBLEMS AVAILABLE

Approval recently of three designs of ASHRAE jewelry by the Emblem and Insignia Special Committee and production by the Society supplier now makes it possible for you to have your choice of Society identifications.

As illustrated, full size



	Price	Fed. Tax	Mailing	Total
Lapel button	3.00	.30	.20	3.50
Key	6.50	.65	.20	7.35
Tie bar	5.25	.52	.20	5.97

Items are 10 kt. gold with blue enamel insets except the tie bar which is rolled gold with 10 kt. emblem.

Use the coupon herewith and write plainly. This will serve as the mailing label on your package. Circle the item or items you wish as listed above and enclose check or money order to cover total cost. Available to members only.

ASHRAE

234 Fifth Avenue, New York 1, N. Y.

NAME .....

ADDRESS .....ZONE ....

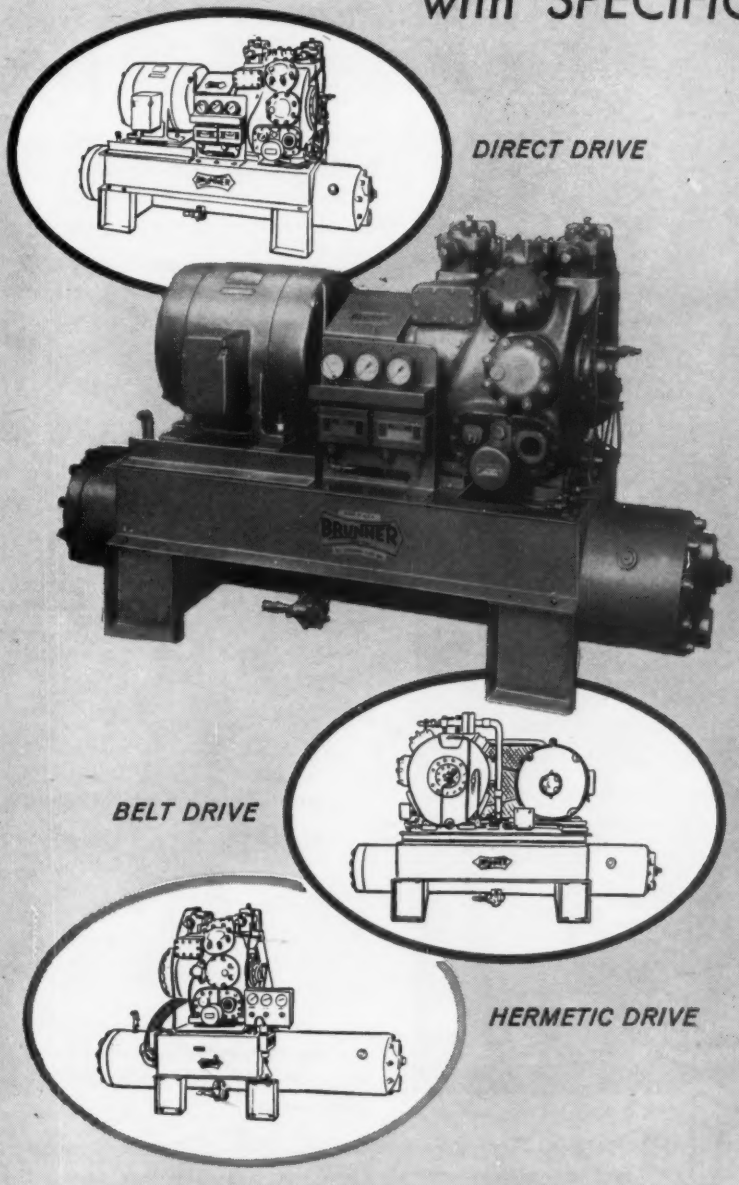
CITY .....STATE .....

Signature .....

from BRUNNER
SINCE 1906

...Multi-Drive Compressors

with SPECIFICATION FLEXIBILITY



Again—from the leader—
a beneficial advance in compressor adaptability.

Brunner's new line of multi-drive units can fully satisfy *any* compressor requirement... providing a specification flexibility that substantially widens application latitude.

As illustrated, the line includes the direct drive model, the hermetically sealed model, and the belt-driven model. And to ensure the integrity of performance for which Brunner has been famous for fifty-three years, these units are constructed of only the highest grade materials; and are equipped with built-in capacity control, oil control valves, replaceable cylinders, and other important features.

The line's horsepower range is 7½-100. Each model is obtainable in either the water-cooled or the evaporative type.

For more information, contact the Dunham-Bush sales engineer near you, or write for Form No. 775.

Dunham-Bush, Inc.

WEST HARTFORD 10 • CONNECTICUT • U. S. A.

DUNHAM-BUSH

AIR CONDITIONING • REFRIGERATION • HEATING • HEAT TRANSFER

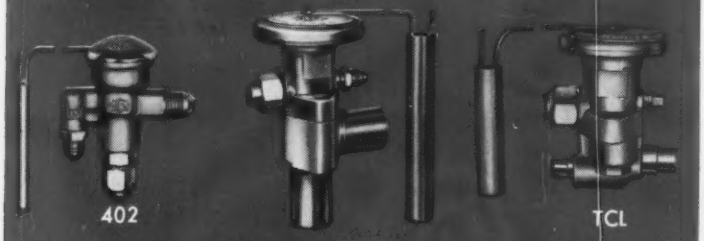
WEST HARTFORD, CONNECTICUT • MICHIGAN CITY, INDIANA
MARSHALLTOWN, IOWA • RIVERSIDE, CALIFORNIA

SUBSIDIARIES

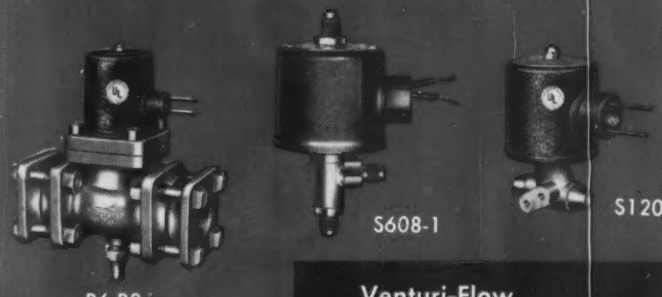
heat-x HEAT-X, INC., BREWSTER, N.Y.
DUNHAM-BUSH (CANADA), LTD., TORONTO, CANADA
DUNHAM-BUSH DUNHAM-BUSH, LTD., PORTSMOUTH, ENGLAND
BRUNNER BRUNNER CORPORATION (CANADA) LTD., PORT HOPE, ONTARIO

ALCO *the one complete line of* REFRIGERANT CONTROLS

Thermo® EXPANSION VALVES
for all refrigerants from 1/4 to 200 tons



SOLENOID VALVES
Sizes & Type for every application and refrigerant



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maximum Screen area—
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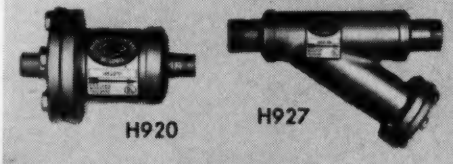
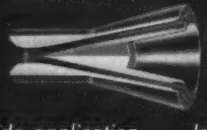


Venturi-Flow DISTRIBUTORS



wide application . . . low pressure drop . . . any position . . . one-piece construction . . . no nozzles

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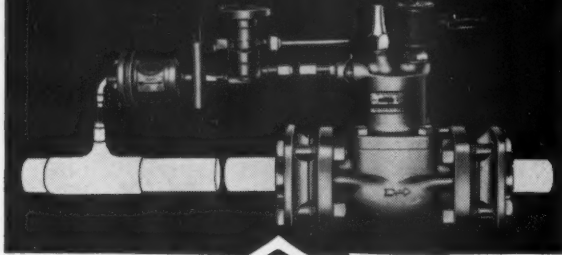
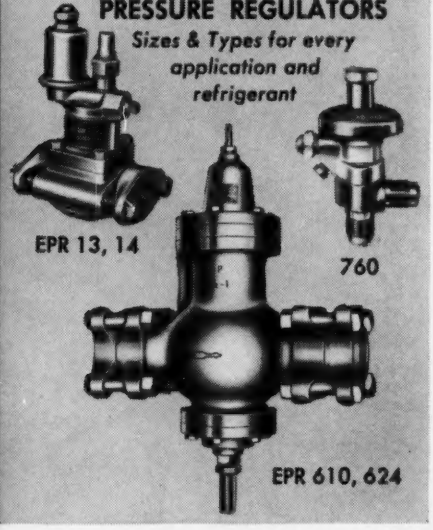


EVAPORATOR PRESSURE REGULATORS
Sizes & Types for every application and refrigerant



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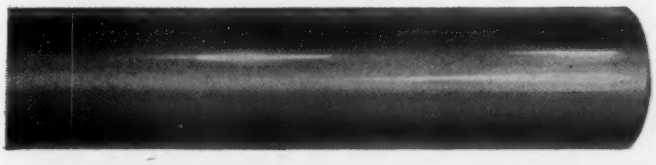
ALWAYS FIT THE TUBE...



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As the originator of the solder-type fitting . . . the Mueller Brass Co. has perfected the design and production techniques so necessary to produce consistently uniform and dimensionally accurate wrot copper fittings that fit right on every job.

Made from high quality Streamline copper tube, Streamline wrot fittings heat faster, more evenly; make smoother, tighter vibration-proof connections.

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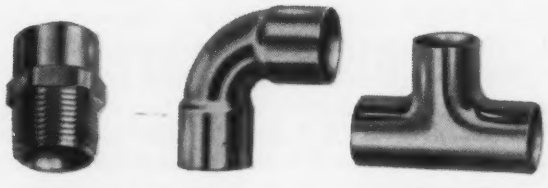

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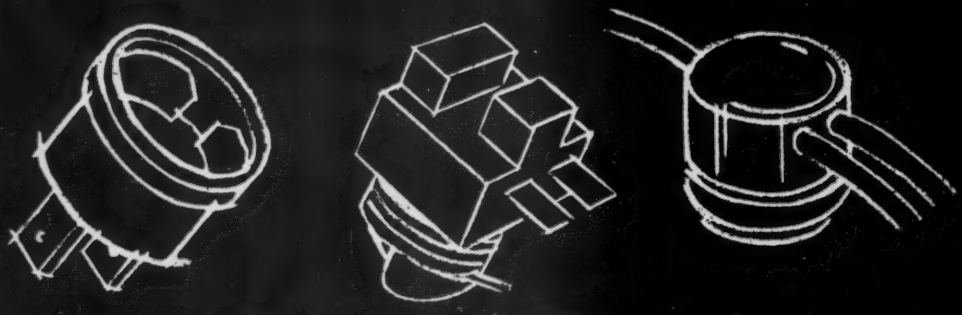

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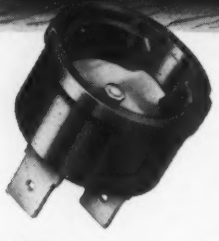
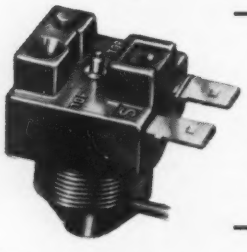


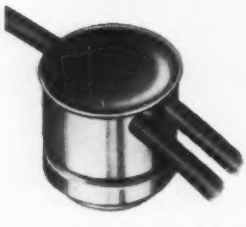
KLIXON DOME MOUNTED PROTECTORS†

. . . permit maximum safe compressor performance under overload conditions . . . shut the motor down when maximum allowable winding temperature is reached . . . automatically restart it when operation can be continued safely.



KLIXON MOTOR STARTING RELAYS†

. . . complete the combination required to start and protect compressor motors. Their positive action over a wide range of voltage and long life eliminates starting troubles.



KLIXON HERMETICALLY SEALED THERMOSTATS

. . . give reliable temperature control unaffected by frost, moisture, altitude or cross-ambient effect . . . available for heating or cooling applications.

†Replacements are now available through distributors

Dependable operation is a must in such equipment as refrigerators, air conditioners, frozen food cabinets, freezers and heat pumps. That is why most manufacturers of compressors and complete equipment specify and use KLIXON Controls.

KLIXON Protectors permit the compressor to operate at maximum safe capacity . . . assure long compressor life. KLIXON Motor Starting relays assure positive starts. And, KLIXON Thermostats give reliable temperature control. The result — refrigeration equipment operates dependably under normal and adverse conditions . . . costly service calls, maintenance and replacements are reduced . . . product reputation and customer goodwill are maintained.

Manufacturers who are looking for more safe capacity in their compressors or refrigeration equipment are invited to find out more about KLIXON Controls. Write.

**Over 200,000,000* KLIXON *Controls are in use in refrigerating and heating equipment.*

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Motor Starting Relays • Thermostats • Precision Switches • Circuit Breakers

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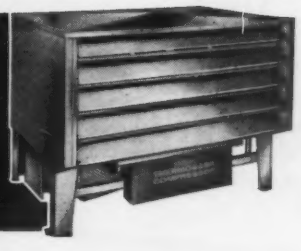

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KRAMER'S outdoor compressor is the *only* compressor designed to operate *outdoors* for *any* application under *all* temperatures and weather conditions.

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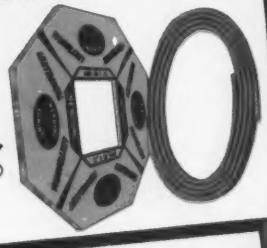

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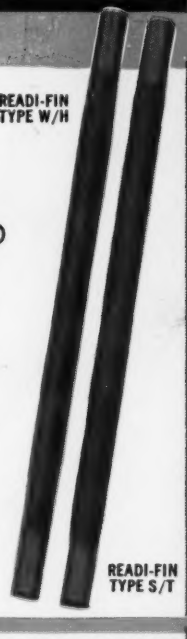

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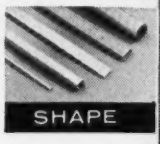

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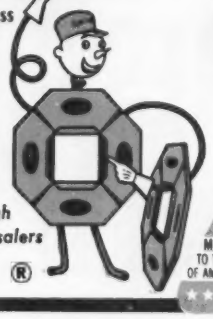

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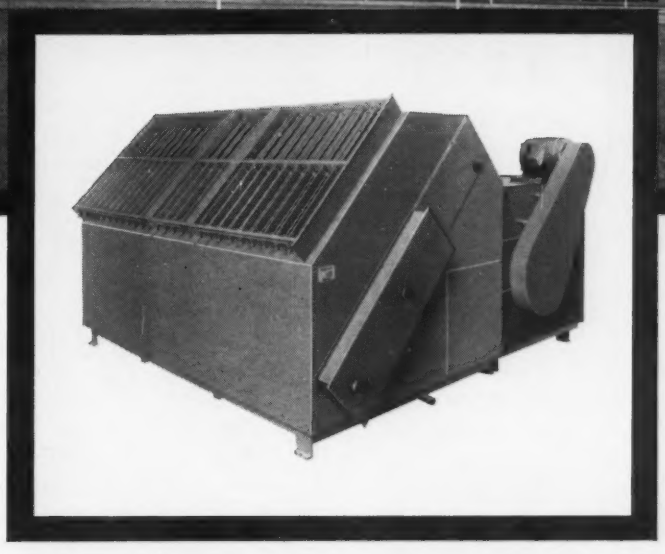

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To match the comfort and luxury of today's air travel, architects and engineers give considerable study to the design of and equipment needed in air terminals. Among the country's outstanding terminals in this aspect is the one found at Daytona Beach, Florida.

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Thermal Engineering manufactures a complete line of finer air conditioning and ventilating equipment for every climate and to fit all architectural requirements. To see how easily, economically and efficiently Thermal equipment will fit into your new building or remodeling plans, write for the complete catalog on Thermal central plant and multizone conditioners, sprayed coil units, heating and ventilating units, heating and cooling coils, and air-cooled condensers.

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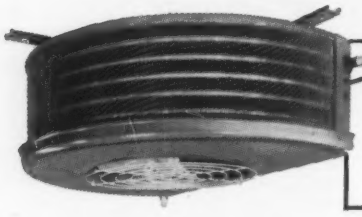

HALF-TURRET HUMI-TEMP
Model HT

This forced convection unit is ideal for walk-in coolers and cold storage rooms. Available in capacities from 2500 to 10600 Btu/hr at 10° TD. Mounts flush to wall and ceiling for maximum head room and storage space. Engineered to provide 100% usage of coil surface. Has built-in heat exchanger, patented LARKIN cross-fin coil, permanently lubricated motors, fully insulated drip pan.

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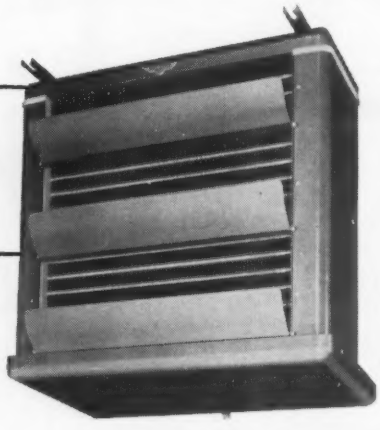

Available in capacities from 2400 to 32000 Btu/hr at 10° TD, which accurately balance condensing units of the same capacity. Will maintain proper temperature and humidity in walk-in coolers and many other applications. Has LARKIN cross-fin coil, insulated non-sweat drip pan, adjustable louvers, permanently lubricated motors. Easily serviced if necessary.

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Applications

THREE AIRCRAFT MANUFACTURERS PARTICIPATE IN B-70 PROGRAM

Supplied with deep freeze chambers capable of producing temperatures of –120 F, North American Aviation, Inc., Chance Vought Aircraft, Inc., and Boeing Airplane Company are participating in a program of research and development on wings for the B-70 Valkyrie intercontinental bombers. The new method of making wings produces a honeycomb structure sandwiched between stainless steel plates, cited as being lighter and sturdier than older types. After being brazed at 1650 F, wing panels are allowed to cool at room temperature, then placed inside the freezing units to be frozen at –100 F.

Tenney Engineering, Inc., has produced the 16 x 26 x 7 and 14 x 27 x 6-ft brine chillers for North American and Chance Vought, respectively, while Refrigeration Engineering Company supplied Boeing's 28 x 10 x 11-ft chamber.

OFFICE BUILDING AIR CONDITIONED WITH DUAL DUCT SYSTEM

To permit individual room control of temperature at all seasons, regardless of variations in thermal loads in any part of the building, a dual duct high velocity air conditioning system was chosen for the Modesto, Calif., Irrigation District office building, to be coupled with Anemostat Corporation's All-Air Units. Ducts of this system are small, requiring a minimum of space, and can be furred above corridors or ceilings or installed as risers at the perimeter of the building. Anemostat units used in conjunction with the dual duct system were designed for mounting in the ceiling, side wall or under windows and can be used without operating the refrigerating cycle.

Located in the basement is the central plant of the air conditioning system, using a heat pump for both heating and cooling. Supplied by two electrically-operated deep-well pumps, water is utilized as the heating medium. Basic element of the refrigeration system is a hermetically-sealed centrifugal compressor designed for automatic operation. During the cooling cycle, the compressor uses the water supplied by the pumps for drawing heat off the air system and, during the heating cycle, to add heat to it.

AIR CONDITIONING FOR LINER

All passenger cabins and public spaces and all crew quarters in the 38,000 ton liner Rotterdam, flagship of the Holland-America Line, are fully air conditioned for year-round passenger comfort. Supplying filtered, cooled and dehumidified air in summer and heated and humidified (if necessary) air in winter are 36 air conditioning units through which cooled or heated water is sent by six pumps. In each cabin, tempera-

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Engineers, architects and contractors are finding this Weksler Specification Bulletin a great time saver!

Designed for "at a glance" information and specifications on Weksler instruments most frequently specified for indicating and recording temperature, pressure and humidity, the bulletin illustrates and describes most of the basic instruments needed in air-conditioning, heating, ventilating, plumbing and piping.

WRITE FOR YOUR COPY OF THE WEKSLER SPECIFICATION BULLETIN

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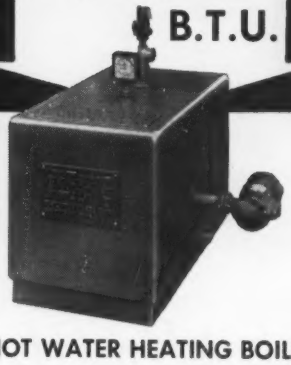

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ture can be controlled by means of a thermostat operating a reheat battery. Air from bathrooms and lavatories is exhausted by 11 fans, while 23 supply and 23 exhaust fans ventilate kitchens, laundry and other service areas.

In the stabilizer room, three steam-turbine driven Carrier centrifugal-type compressors, with a maximum cooling capacity of 1,830 ton, were installed to handle the ship's cooling load. Other units in the system were located at various points throughout the ship, with nearly seven miles of ducts bringing conditioned air to the cabins.

UPDRAFT VENTILATION CHANGED TO DOWNDRAFT SYSTEM

As part of a modernization program at Youngstown Sheet and Tube Company's Campbell Works, Sturtevant Div of Westinghouse Electric Corporation is supplying equipment to force-ventilate twelve mainstand motors and two large motor-generator sets. The original updraft ventilating system at the plant's 79-in. hot strip mill is being changed to a down-draft non-recirculating system. However, it will be possible to recirculate warm air from the machines back to the motor room during winter operation.

Drawing air through filters and delivering it to the main motor room area will be twelve vertically-mounted vaneaxial fans, with a total capacity of 825,000 cfm. In the basement, seven airfoil centrifugal fans will draw approximately 630,000 cfm of air through the motors and generators. Three tube-axial and four centrifugal fans, also located in the basement, will then exhaust this air to the atmosphere. Total connected hp to the fans is 1515.

SWEDEN HAS ARTIFICIALLY FROZEN ICE SKATING RACE TRACK

To permit the holding of major national and international competitions, the rinks constructed at Ullevi Sports Stadium in Gothenburg, Sweden, had to satisfy stringent requirements and are expected to serve as models for future installations. A number of technical refinements have been introduced into the refrigeration process, such as facilities for heating the ice, for maintaining a constant ice temperature of 30 F on the racing rink and 21 F on the ice hockey rink and for heating or refrigerating different parts of a rink at the same time.

Incorporating a total length of 295,000 ft of hot-dip galvanized pipe, the rinks consist of "mats" of tubing on which the ice-bearing course is built. They are cooled by circulation of calcium chloride brine through the pipes and the ice is built up in the ordinary manner by water flushing. Four separate systems of piping service the various areas, permitting considerable adaptability of the ice temperature to the different conditions prevailing on the rinks.

Four nine-cylinder compressors using Refrigerant 22 and driven by 175 hp motors comprise the refrigerating plant at the stadium. Working together, the compressors can remove a total of 5,161,000 Btu/hr from the rinks. Also included in the plant are four

Ever hear of a bashful air-cooled condenser?

Check the new Halstead & Mitchell vertical air flow condenser

H&M's new ACV Air-Cooled Condenser with vertical air flow hates to be showy. It's so low and so quiet, you hardly know it's there—very appealing to owners, their neighbors, architects and engineers!

Roof loading is low, too, and air flow noise is directed away from surrounding structures. This delights building owners and tenants alike.

Vertical air flow models are available in 5 to 100 tons. And like all H&M Air-Cooled Condensers, the ACV series features exclusive Turbu-Flo fins, spaced wide to prevent clogging by air-borne dirt. Multiple circuiting is available for your specific needs *at no extra cost.*

Get the whole story on H&M Air-Cooled Condensers—with propeller or centrifugal fan. Ask your refrigeration wholesaler for a copy of the new bulletin AC-102. Or write to Halstead & Mitchell, Bessemer Bldg., Pittsburgh 22, Pa.

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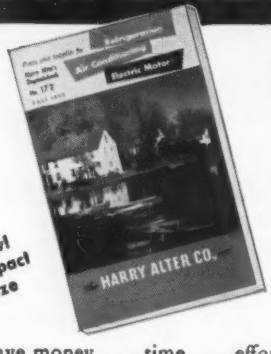

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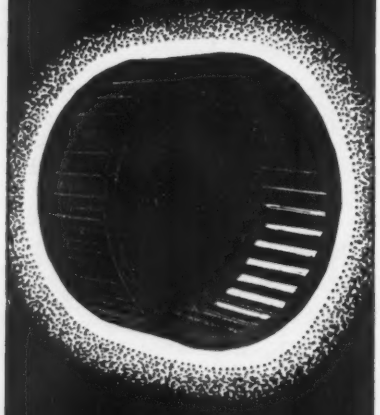

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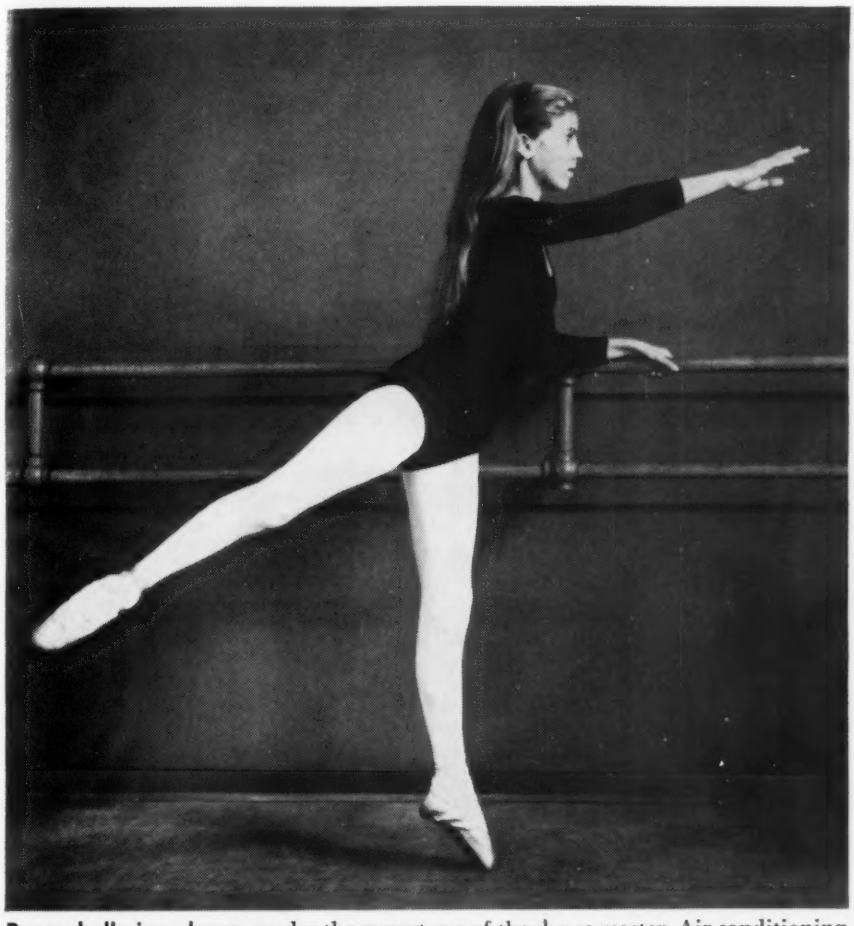

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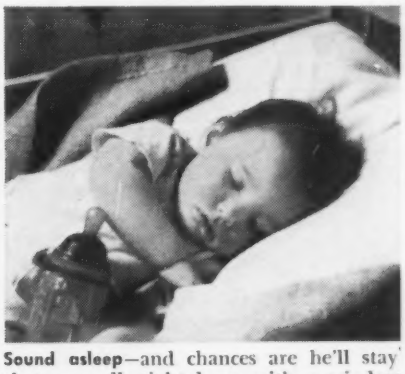
Plenty of atmosphere pervades this swank nightspot—and it isn't smoke-filled! Air-conditioning gently circulates the air and provides a gentle stimulus, too, for increased business during the summer.



Sound asleep—and chances are he'll stay that way all night long, with a window air-conditioner in the nursery. Air-conditioning keeps the temperature at a comfortable level, eliminates drafts and stuffiness.

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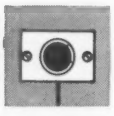
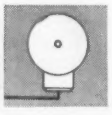
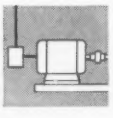


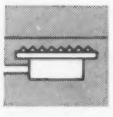
to actuate a signal light—signal an attendant to make the right moves in operating valves, pumps and the like—signal him when flow stops in a water cooled compressor, water cooled bearing and so on.



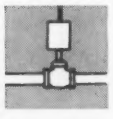
to sound an alarm—when flow stops in a process system or in any water cooled devices.



to start or stop motors—start pumps in sequence in multiple stage flow systems; start standby pumps; stop automatically controlled units if cooling water system fails; stop compressors in cooling systems when flow stops. These are *control* functions, and almost endless.



to start or stop automatic burners—start a booster heater when water draw occurs; stop burner if flow is improperly retarded; make sure of circulation in a boiler before burner is permitted to start.



to actuate metering device—open valve in chemical feeder line; start mixing in secondary line whenever flow starts in primary line.

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